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Appendix 1. The Cross Bracing Protocol

| Week | Brace | Aims | Physiotherapy-supervised rehabilitation |
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| 1-4 | ROM brace fitted and locked at 90 degrees NWB with crutches or mobility scooter | <ul style="list-style-type: none"> Maintain knee flexion at 90° in brace 24/7 Minimise local and global muscle atrophy Control swelling and pain DVT risk mitigation: Hydration, calf pump exercises and anticoagulation (Rivaroxaban 10mg daily) Counsel re anticipated initial discomfort No NSAIDs medications; no aspiration/drainage of hemarthrosis | <ul style="list-style-type: none"> Manual therapy weekly, maintaining 90° knee flexion Cryotherapy <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> Quadriceps and hamstring co-contractions. Calf Theraband plantarflexion Hip abduction and extension Contralateral limb: single leg press, leg extension, hamstring curls, calf raise, glute bridge, core activation. Upper body strengthening. Ski Ergometer Grinder |

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| 5-6 | <p>Week 5 = 60 degrees to 90 degrees</p> <p>Week 6 = 45 degrees to 90 degrees</p> <p>NWB with crutches</p> | <ul style="list-style-type: none"> Minimise local and global muscle atrophy Maintain specified knee ROM DVT risk mitigation: Hydration, calf pump exercises and anticoagulation (Rivaroxaban 10mg daily). | <ul style="list-style-type: none"> Manual therapy and exercises weekly in specified range (brace can come off for physiotherapy). <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> Quadriceps and hamstring co-contractions at varying angles Continue calf Theraband plantarflexion Hip abduction and extension with ankle weights or Theraband Continue Contralateral limb; single leg press, leg extension, hamstring curls, calf raise, glute bridge, core activation Upper body strengthening. Ski Ergometer Grinder |
| 7-8 | <p>Week 7 = 30 degrees to FULL FLEXION°</p> <p>Week 8 = 20 degrees to FULL FLEXION</p> <p>PWB with crutches</p> | <ul style="list-style-type: none"> Minimise local and global muscle atrophy Maintain specified knee ROM DVT risk mitigation: Hydration, calf pump exercises and anticoagulation (Rivaroxaban 10mg daily). | <ul style="list-style-type: none"> Manual therapy and exercises weekly in specified range; Gait retraining. <p>Rehabilitation exercises, as per week 5-6 plus;</p> <ul style="list-style-type: none"> Wall squats/holds (Week 7=45°, Week 8=30°). Body weight squats within brace limits |
| 9 | <p>Week 9 = 10 degrees to FULL FLEXION.</p> | <ul style="list-style-type: none"> Increase knee ROM Overcome anticipated fixed flexion contracture | <ul style="list-style-type: none"> Manual therapy and exercises weekly in specified range. Gait retraining. <p>Rehabilitation exercises:</p> |

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| | <p>Week 10 = UNRESTRICTED ROM brace (0-120°+)</p> <p>Wean off crutches. Full weight bearing</p> | <ul style="list-style-type: none"> • Increase muscle strength of lower limbs • Improve proprioception • Cease Rivaroxaban anti-coagulation | <ul style="list-style-type: none"> • Knee range of motion exercises (heel slides). • Pilates reformer/ leg press • Body weight squats • Bridges - hamstring and gluteal • Crab walks/ monster walks • Calf raises • Static balance exercises • Exercise bike if able to achieve over 100° flexion. • Upper body strengthening. • Grinder |
| 10-12 | <p>Unrestricted ROM brace</p> <p>Full weight bearing</p> <p>End of week 12: Medical consultation and 12-week MRI.</p> | <ul style="list-style-type: none"> • Increase knee ROM • Increase muscle strength • Improve proprioception | <ul style="list-style-type: none"> • Weekly manual therapy and exercises. • Gait retraining. <p>Rehabilitation exercises, as per week 9 plus;</p> <ul style="list-style-type: none"> • Leg press (single leg) • Hamstring curl machine • Standing and seated calf raise machine • Static balance exercises. • Exercise bike |
| 13-14 | <p>Week 13 = Removal of brace. Formal clinical review and repeat MRI.</p> | <ul style="list-style-type: none"> • Increase muscle strength • Improve proprioception | <ul style="list-style-type: none"> • Weekly manual therapy and exercises. • Gait retraining. <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> • Continue/progress hamstring and quadriceps strengthening • Addition of single leg squatting/Bulgarian squats • Lunges (half range) • Dynamic balance exercises |

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| | <p>Full weight bearing</p> <p>Brace is worn in high risk environments from week 13-16</p> | | <ul style="list-style-type: none"> • Jogging on spot/mini tramp • Light Skipping • Exercise bike • Upper body • Grinder |
| 15-16 | No brace, full weight bearing. | <ul style="list-style-type: none"> • Increase muscle strength • Improve proprioception • Introduce Running (must meet return to running criteria) | <ul style="list-style-type: none"> • Manual therapy • Running analysis <p>Criteria for commencing slow running:</p> <ul style="list-style-type: none"> • No effusion • Full ROM • Quadriceps and hamstring strength >80% LSI • Star excursion balance test >90% LSI <p>Rehabilitation exercises:</p> <p>Continue/progress previous strength and dynamic balance exercises.</p> <ul style="list-style-type: none"> • Addition of walking lateral movements e.g. crab walking, side stepping, grapevines etc. • Addition of jumping/landing • Exercise bike • Swimming • Cross trainer/elliptical • Grinder |

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| | | | <ul style="list-style-type: none"> • Straight line running only (if meeting above criteria) |
| 17 | No brace, full weight bearing. | <ul style="list-style-type: none"> • Increase muscle strength • Improve proprioception • Introduce faster running | <ul style="list-style-type: none"> • Manual therapy as required <p>Criteria for progression to faster running:</p> <ul style="list-style-type: none"> • Completion of slower running with no pain or effusion <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> • Continue/progress previous exercises • Introduce faster running (if meeting above criteria) |
| 18 | No brace, full weight bearing. | <ul style="list-style-type: none"> • Increase muscle strength/ proprioception • Introduce Agility exercises | <ul style="list-style-type: none"> • Manual therapy as required <p>Criteria for commencing agility exercises:</p> <ul style="list-style-type: none"> • Adequate control with jumping and landing, double and single leg • Completion of faster straight line running with no pain or effusion. <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> • Continue/progress previous exercises • Introduce agility exercises (if meeting above criteria) |
| 19 | No brace, full weight bearing. | <ul style="list-style-type: none"> • Increase muscle strength/ proprioception • Introduce hopping | <ul style="list-style-type: none"> • Manual therapy as required <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> • Continue/progress previous exercises • Introduce hopping exercises |
| 20 | No brace, full weight bearing. | <ul style="list-style-type: none"> • Increase and maintain muscle strength/ proprioception | <ul style="list-style-type: none"> • Manual therapy as required |

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| | | <ul style="list-style-type: none"> Consider return to training from week 20 onwards | <p>Criteria for return to training</p> <ul style="list-style-type: none"> Single leg hop >90% LSI Knee extension strength >90% LSI Hamstring strength >90% LSI Good dynamic knee control on single leg land from step Star excursion balance test >90% LSI <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> Continue/progress previous exercises Return to training (if meeting above criteria) |
| 26+ | No brace, full weight bearing. | <ul style="list-style-type: none"> Increase and maintain muscle strength/ proprioception Consider return to sport around 9-12 months (the decision to return to sport is goal and criteria based) | <ul style="list-style-type: none"> Manual therapy as required <p>Criteria for return to play</p> <ul style="list-style-type: none"> Triple Hop/lateral hop/ single hop >90% LSI Single leg press 1.8x BW Star excursion balance test >90% LSI <p>Rehabilitation exercises:</p> <ul style="list-style-type: none"> Continue/progress previous exercises <p>Return to play (if meeting above criteria)</p> |

ROM: Range of movement, NSAIDs: Non steroidal anti inflammatory drugs, N/PWB: Non/ Partial weight bearing, DVT: Deep vein thrombosis, LSI: Limb symmetry index; BW: Body weight.