Appendix 1. The Cross Bracing Protocol

<table>
<thead>
<tr>
<th>Week</th>
<th>Brace</th>
<th>Aims</th>
<th>Physiotherapy-supervised rehabilitation</th>
</tr>
</thead>
</table>
| 1-4  | ROM brace fitted and locked at 90 degrees | • 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 | • Manual therapy weekly, maintaining 90° knee flexion  
• Cryotherapy  
Rehabilitation exercises:  
• 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 |
<table>
<thead>
<tr>
<th>Week</th>
<th>Range</th>
<th>NWB or PWB</th>
<th>Crutches</th>
<th>Rehabilitation Exercises</th>
</tr>
</thead>
</table>
| 5-6  | 60-90 degrees | NWB with crutches | • Minimise local and global muscle atrophy  
• Maintain specified knee ROM  
• DVT risk mitigation: Hydration, calf pump exercises and anticoagulation (Rivaroxaban 10mg daily). | • Manual therapy and exercises weekly in specified range (brace can come off for physiotherapy).  
Rehabilitation exercises:  
• 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  | 30-180 degrees | PWB with crutches | • Minimise local and global muscle atrophy  
• Maintain specified knee ROM  
• DVT risk mitigation: Hydration, calf pump exercises and anticoagulation (Rivaroxaban 10mg daily). | • Manual therapy and exercises weekly in specified range;  
Gait retraining.  
Rehabilitation exercises, as per week 5-6 plus;  
• Wall squats/holds (Week 7=45˚, Week 8=30˚).  
• Body weight squats within brace limits |
| 9    | 10-180 degrees | | • Increase knee ROM  
• Overcome anticipated flexion contracture | • Manual therapy and exercises weekly in specified range.  
Gait retraining.  
Rehabilitation exercises: |
<table>
<thead>
<tr>
<th>Week 10 =</th>
<th>Week 11 =</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNRESTRICTED ROM brace (0-120°+)</td>
<td>UNRESTRICTED ROM brace (0-120°+)</td>
</tr>
<tr>
<td>Wean off crutches. Full weight bearing</td>
<td>Wean off crutches. Full weight bearing</td>
</tr>
<tr>
<td>10-12</td>
<td>11-12</td>
</tr>
<tr>
<td>Medical consultation and 12-week MRI.</td>
<td>Medical consultation and 12-week MRI.</td>
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</tbody>
</table>

- Increase muscle strength of lower limbs
- Improve proprioception
- Cease Rivaroxaban anti-coagulation
- 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
- Weekly manual therapy and exercises.
- Gait retraining.
- Weekly manual therapy and exercises.
- Gait retraining.

Rehabilitation exercises, as per week 9 plus:
- Leg press (single leg)
- Hamstring curl machine
- Standing and seated calf raise machine
- Static balance exercises.
- Exercise bike

Rehabilitation exercises:
- Continue/progress hamstring and quadriceps strengthening
- Addition of single leg squatting/Bulgarian squats
- Lunges (half range)
- Dynamic balance exercises

End of week 12: Medical consultation and 12-week MRI.

- Increase knee ROM
- Increase muscle strength
- Improve proprioception
- Exercise bike if able to achieve over 100° flexion.
| Full weight bearing | • Jogging on spot/mini tramp
• Light Skipping
• Exercise bike
• Upper body
• Grinder |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Brace is worn in high risk environments from week 13-16</td>
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</tbody>
</table>
| 15-16 No brace, full weight bearing. | • Increase muscle strength
• Improve proprioception
• Introduce Running (must meet return to running criteria) |
|  | • Manual therapy
• Running analysis |

Criteria for commencing slow running:
• No effusion
• Full ROM
• Quadriceps and hamstring strength >80% LSI
• Star excursion balance test >90% LSI

Rehabilitation exercises:
Continue/progress previous strength and dynamic balance exercises.
• Addition of walking lateral movements e.g. crab walking, side stepping, grapevines etc.
• Addition of jumping/landing
• Exercise bike
• Swimming
• Cross trainer/elliptical
• Grinder
<table>
<thead>
<tr>
<th>Day</th>
<th>Status</th>
<th>Criteria for Progression to Faster Running</th>
<th>Criteria for Commencing Agility Exercises</th>
<th>Rehabilitation Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>No brace, full weight bearing.</td>
<td>Increase muscle strength</td>
<td>Manual therapy as required</td>
<td>Continue/progress previous exercises, introduce agility exercises (if meeting above criteria)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Improve proprioception</td>
<td>Completion of slower running with no pain or effusion</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduce faster running</td>
<td>Adequate control with jumping and landing, double and single leg</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Completion of faster straight line running with no pain or effusion</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>No brace, full weight bearing.</td>
<td>Increase muscle strength/proprioception</td>
<td>Manual therapy as required</td>
<td>Continue/progress previous exercises, introduce agility exercises (if meeting above criteria)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduce Agility exercises</td>
<td>Adequate control with jumping and landing, double and single leg</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>No brace, full weight bearing.</td>
<td>Increase muscle strength/proprioception</td>
<td>Manual therapy as required</td>
<td>Continue/progress previous exercises, introduce hopping exercises</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Introduce hopping</td>
<td>Adequate control with jumping and landing, double and single leg</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Completion of faster straight line running with no pain or effusion</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>No brace, full weight bearing.</td>
<td>Increase and maintain muscle strength/proprioception</td>
<td>Manual therapy as required</td>
<td>Continue/progress previous exercises, introduce hopping exercises</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adequate control with jumping and landing, double and single leg</td>
<td></td>
</tr>
</tbody>
</table>
Consider return to training from week 20 onwards

Criteria for return to training
- 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

Rehabilitation exercises:
- Continue/progress previous exercises
- Return to training (if meeting above criteria)

| 26+ | No brace, full weight bearing.  
|     | • 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)  
|     | • Manual therapy as required  
|     | Criteria for return to play  
|     | • Triple Hop/lateral hop/single hop >90% LSI  
|     | • Single leg press 1.8x BW  
|     | • Star excursion balance test >90% LSI  
|     | Rehabilitation exercises:  
|     | • Continue/progress previous exercises  
|     | Return to play (if meeting above criteria) |