

SPORTS SPECIFIC REHABILITATION

CONTENT AND CONSIDERATIONS

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Athletes who sustain an injury to their anterior cruciate ligament (ACL) have high expectations (88%) after following ACL reconstruction (ACLR) to return to their pre-injury level of sports, but only 55% get back to that same level^{4,6,7}. Despite the volume of research in the areas of ACL injury prevention, surgical, nonsurgical management and return to participation, primary and secondary injuries continue to occur at an alarming rate, at all participation levels⁸⁻⁹.

One part of the return-to-sport (RTS) program after ACL reconstruction that has received less attention is on-field rehabilitation: the period when the athlete is transitioning from gym-based rehabilitation to the competitive team environment^{2,3,13}. On Field Rehabilitation is considered an important element due to the ecological validity offered by using various training stimuli to stimulate tissue loading in a way which more similar to that experienced during training and competition³. A vital component of this framework is the safe and effective return of players to their preinjury chronic running load, whilst progressively integrating the qualitative aspects of movement, football-

specific skills, and cognitive stresses integral to competitive match-play^{14,10,11}.

Sports Specific on-field rehabilitation is an essential element for athletes to test their progression, build confidence and improve performance after the ACL reconstruction. It enhances their readiness to return to training by recreating the chaotic environment of their sport with regards to the physical, technical, and neurocognitive demands of the sport while building up their exposure running volume and intensities they will be transitioning back to. This process is crucial to bridge the gap for a safe resumption of full-team training, then gradual transition to full competition thereby reducing the risk of reinjury and optimizing performance.

Successful on-field rehabilitation is achieved with emphasis on rehabilitation considerations and sport-specific performance needs. Consideration of the late phase rehabilitation principles on one side (such as neuromuscular control and movement quality) and of training and match demands on the other hand is important to ensure that an athlete is well prepared for RTS^{2,5}. Buckthorpe et al, suggest considering this complicated last phase

of rehabilitation as comprising 4 pillars: 1 restoring movement quality, 2 physical conditioning, 3 restoring sport-specific skills, and 4 progressively developing chronic training load^{1,2}.

Following this structure the sports specific football program in Aspetar comprises 5 field-based training stages:

1. linear movement,
2. multidirectional movement,
3. soccer-specific technical skills,
4. soccer-specific movement, and
5. practice simulation.

At the conclusion of these stages the athlete will then follow a progressive return to team practice and gradual return to competitive match play. This process allows the player to focus on regaining football-specific movement with physical, technical, and tactical performance while developing psychological readiness to perform^{2,3}.

Patients are referred by their treating physiotherapist to commence Aspetar's sports specific on-field rehabilitation program once they have met the entry criteria (Table 1) and completed an assessment by the sports rehabilitation physiotherapist. Criteria for progression through the sports specific program include

TABLE 1

Entry Criteria:	Discharge criteria for competitive athletic populations:
<p>At least 4 months post op for ACLR and 5 months post op for ACL Revision and adolescents below 17 years old. If earlier, surgeon's approval required.</p> <p>Symmetrical Extension / Flexion >130°</p> <p>No pain or increased swelling with activity</p> <p>Isokinetic testing quads LSI ≥ 75 % for quads and hamstrings</p> <p>Hip Abduction and Adduction strength > 90% LSI</p> <p>Single Leg Drop Jump and CMJ (height and RSI) > 75% LSI</p> <p>Completed the Running Curriculum (6X200m at 16km/h, 12km/h for court sports/recreational)</p> <p>Appropriate movement quality during functional movements (SL Squat to 90 degrees knee flexion, SL Landing in all 3 planes, symmetrical lateral push off and cross over)</p>	<p>Hip Abduction > 40% BW</p> <p>Hip Adduction > 40% BW</p> <p>Hip External Rotation > 30% BW</p> <p>SL Squat below 90° knee flexion with neutral control</p> <p>Soleus > 200% BW</p> <p>Quad > 300% BW</p> <p>Hamstring > 170% BW</p> <p>CMJ – LSI < 10% for concentric and eccentric impulse and jump height.</p> <p>Drop Jump – LSI < 10% for concentric and eccentric impulse and peak landing force; RSI > 1.5 for DLDJ and > 0.5 for SLDJ. < 10% LSI for knee extension moments and knee valgus moments</p> <p>Running – < 10% LSI for VGRF, knee flexion angle, knee extension moment and neutral midstance at hip and pelvis. Have tolerated running curriculum and sports specific curriculum.</p> <p>Change of Direction - < 10% LSI vGRF, Knee flexion angle, Knee extension moment, knee valgus moment. Have tolerated sports specific curriculum.</p> <p>Cleared sports specific pain free, no swelling, technical competency.</p>

Table 1: Entry criteria to commence on-field rehabilitation after ACLR for a football player, and discharge criteria for returning for final surgical review to resume team training.

TABLE 2

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Goal	Linear movements	Multidirectional Movements	High Intensity Linear and Multidirectional Combined	Football Specific Movement & Skill Restoration	Training Simulation
Components	<ul style="list-style-type: none"> Linear running Acceleration-deceleration Passing/ dribbling Reactive drills Running load and conditioning. 	<ul style="list-style-type: none"> Multidirectional Running, Acceleration-Deceleration Passing / dribbling Reactive drills Running Load & Conditioning 	<ul style="list-style-type: none"> High Intensity Linear Multidirectional Combined Passing / Dribbling Reactive drills Running Load & Conditioning 	<ul style="list-style-type: none"> Football Specific Skills (Crossing Shooting) Passing/ dribbling Contested Drills High Speed Running (Shooting Under Fatigue) 	<ul style="list-style-type: none"> Football Specific Skills (Crossing Dribbling Shooting) Passing Dribbling High Intensity Sided Real Game Scenarios High Speed Running (Shooting Under Fatigue) Position Specific
Frequency	Monday, Thursday	Monday, Thursday	Monday, Thursday	Sunday, Tuesday, Thursday	Sunday, Tuesday, Thursday
Total Distance	3000m	3500m	3500- 4000m	4000m (High-speed running: 400m)	4500m (High-speed running 400- 800m)
				Mid Stage testing	Discharge testing
Criteria to progress	No pain, no flare-up, confident	No pain, no flare-up, confident	No pain, no flare-up, confident	<ul style="list-style-type: none"> Vertical jumps Single Leg hop for distance CoD 90° Cardiovascular Endurance Test (Yo-Yo) 	<ul style="list-style-type: none"> Vertical jumps Single Leg hop for distance CoD 90° Cardiovascular Endurance Test (Yo-Yo)

Table 2: Outline of the 5 stage on-field rehabilitation program for an ACL-reconstructed football player.

pain free participation, no flare-up after a session, athlete confidence and execution with each phase of drills. When athletes complete the 3rd stage of the protocol they are comprehensively re-assessed, including biomechanical analyses of vertical jumps, single leg hop for distance, 90° direction change, and a cardiovascular endurance test (Yo-Yo) to chart progress and identify any residual deficits which can be targeted and addressed through the final two stages. On completion of the 5th and final stage, the athlete returns to the assessment laboratory for a discharge testing. Should they successfully meet all discharge criteria for all these tests, they are then referred back to the treating surgeon for their final review and possible clearance for return to unrestricted

training. Upon returning to training, the GPS data from the rehabilitation sessions are provided to the club's medical and physical conditioning teams to assist with sensible return to normal training loads given the individual's training history.

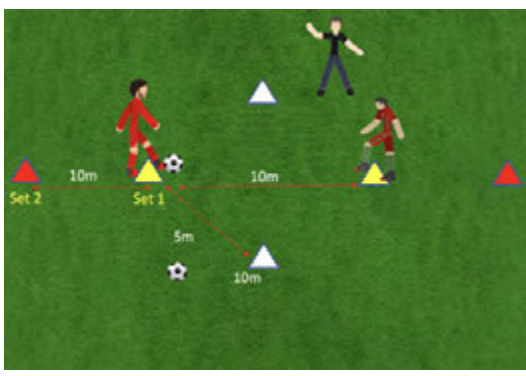
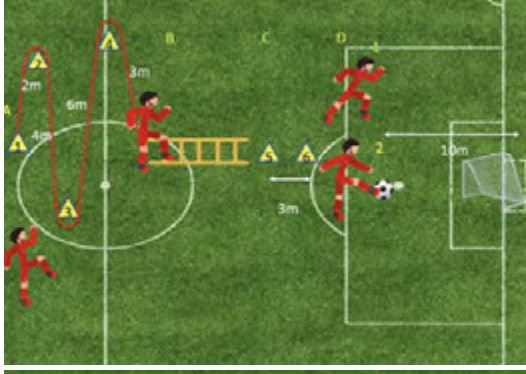



CONCLUSION

Sports-specific on-field rehabilitation plays a crucial role in an athlete's journey to recover from ACL reconstruction and return to their pre-injury level of sports participation. The process involves mimicking the chaotic on-field environment to build confidence and improve performance. The rehabilitation process which started with slow, controlled in-plane movements culminates with the on-field stage which progressively exposes

athletes to out-of-plane movements in a less controlled competitive environment. As such, on-field rehabilitation offers an essential addition to the rehabilitation program that aligns rehabilitation principles with sport-specific performance needs, facilitating a safe and effective return to play. By focusing on movement quality, physical conditioning, sport-specific skills, and progressive development of chronic training load, athletes are mentally and physically preparing for their return to full team training and then competitive match play. The incorporation of the five stages of on-field rehabilitation helps ensure a well-structured and successful return-to-sport plan for athletes following ACL reconstruction.

TABLE 3

<p>Stage 1: Linear Running</p>	<p>We arrange the cones as shown beside</p> <p>AIM:</p> <p>Set 1: The player runs forward from cone 1 to cone 2, lateral shuffle right from 2 to 3, lateral shuffle left from 3 to 4 and forward again from 4 to 5. He returns with the same pattern.</p> <p>Set 2: The player runs forward through the cones in a slalom way and comes back same way forward again.</p> <p>Set 3 He runs lateral shuffle right through the cones and returns back lateral shuffle left.</p> <p>Easy pace</p> <p>Total Distance: 120m</p> <p>Total Time: N/A</p> <p>Recovery Time : 1' after each set</p> <p>No. of Reps: 6 for each set</p> <p>Total distance covered: 360m</p>	
<p>Stage 1: Passing - Dribbling</p>	<p>We arrange the cones as shown beside</p> <p>AIM:</p> <p>Set 1: The player is dribbling the ball with i) touches between the inside of the feet from his initial position until next cone and coming back with the same flow, ii) roll the ball right ways iii) roll the ball left ways iv) roll the ball backwards. Set 2: The player starts from the middle of the two parallel cones and passes the ball to another player or the instructor. He shuffles right to his right cone and left to his left cone before he receives the ball back in the middle, passes with first touch and repeat the drill with the same flow.</p> <p>Set 3: Like Set 2 but now he runs backwards to the cone behind him and forward to initial position. Passing with the same flow.</p> <p>All above for 1' X 3 times.</p> <p>Time for each set: 1'</p> <p>Total Time: 15'</p> <p>Recovery Time : 1' after each of 3 sets</p> <p>No. of Reps: 3 for each set</p> <p>Total distance covered: 1080m</p>	
<p>Stage 2: Multidirectional Running</p>	<p>We arrange the cones as shown beside</p> <p>AIM:</p> <p>Set 1: The player starts from cone 1 and runs to cone 2 50% of his maximum speed. When he is reaching cone 2 he turns i) 45° left or right and he runs to cone 3 or 4, ii) 90° left or right to cone 5 or 6, iii) 135° left or right and he runs to cone 7 or 8.</p> <p>Set 2: The player upon reaching cones 3,4,5,6,7,8 like Set 1, he receives a pass, he passes the ball back with first touch and sprints towards cone 9.</p> <p>Set 3: Same like previous set but the player starts with ball dribbling from cone 1 until cone 9.</p> <p>Total Distance: 200/400/400m</p> <p>Total Time: N/A</p> <p>Recovery Time: 1' after each Set</p> <p>No. of Reps: 2 for each Set</p> <p>Total distance covered: 1000m</p>	

<p>Stage 2: Reactive Drills</p>	<p>We arrange the cones as shown beside</p> <p>AIM:</p> <p>Set 1: Two players are dribbling the ball with first touch until the instructor whistles once so they have to run to their right white cone, stop once with the involved leg, once with the uninvolved and return to initial position backwards to continue with the same flow. If the instructor whistles twice they have to run to their left white cone. They continue with the same flow for 2'.</p> <p>Set 2: Same drill like above but instead of returning to the yellow cone after reaching the white, they have to run to the red, stop with the other leg than the one they stopped at the white cone, and return to the yellow. They continue with the same flow for 2'.</p> <p>Time for each set: 2' Total Time: 16' Recovery Time: 2' after each rep No. of Reps: 2 for each set Total distance covered: 1000m</p>	
<p>Stage 3: High Intensity Linear & Multidirectional</p>	<p>We arrange 6 cones, a ladder and a mini goal with a ball as shown beside.</p> <p>AIM:</p> <p>Set 1: The player performs 4 different drills in a row with high speed (80-90%). A: He sprints in a zig zag figure around cones 1-2-3-4. B: He does the "inside foot in the ladder" drill. C: He sprints to cone 6 and backpedals to cone 5 before he sprints 90-100% for 10 meters (D). He repeats 6 times.</p> <p>Set 2: The player performs 4 different drills in a row with high speed (80-90%). A: He sprints in a zig zag figure around cones 1-2-3-4. B: He does the "inside foot in the ladder" drill. C: He sprints to cone 6 and backpedals to cone 5 before he shoots the ball at the mini goal. He repeats 6 times.</p> <p>Total Distance: 35m Total Time: N/A Recovery Time: 1' after completion of 1st Set No. of Reps: 6 for each set Total distance covered: 210m</p>	
<p>Stage 3: Passing Dribbling</p>	<p>We arrange the cones, as shown beside.</p> <p>AIM:</p> <p>Each of the two cone markers no.1 & no.4 is occupied by players. We place three more cones no.2, no.3 & no.5 as per image beside. There is one more player at cone no.2. Player from cone no.1 is playing an 1-2 passing with player at cone no.2. Player no.2 is passing the ball in the middle of the drill (3) and moves to cone no.3. Player no.1 is passing to player at cone no.4 and him is passing to player no.2 but at cone no.3. Player from cone no.4 is overlapping around cone no.5 and switches to the other side at cone no.1. Upon reaching cone no.5 he is receiving a pass from player at cone no.3. The drill starts over again with the players into their new positions.</p>	
<p>Stage 4: Crossing - Shooting</p>	<p>AIM:</p> <p>Set 1: Players No.1 & No.2 start sprinting from cone 1 to 2 and cutting from 2 to 3 with full speed as a 40m RSA drill. On the way back to cone 1, following the same route, player No.1 is passing the ball to No.2 who passes the ball with first touch to No.1 again and starts running across the blue highlighted route, overlapping cone 1 and getting into the penalty box. Player No.1 is overlapping cone 1 with the ball, following the red highlighted route, and crosses the ball to player No.2 who scores with one touch.</p>	
<p>Stage 4: Contested Drills</p>	<p>We arrange the boundary poles, mini hurdles and mini goals as shown beside</p> <p>AIM:</p> <p>Set 1: The player No.1 starts from task 1 which is DL – high knees – jumping above the mini hurdles, zig zag running through the boundary poles which is task 2 and then a ball is played from another player (No.2) 10 meters in front of him who attempts to score to either one of the two mini goals and this is task 3. The task will be completed after player's, No.1, action which should be a defending reaction of kicking the ball away.</p> <p>Set 2: The player No.1 starts from task 1 which is bilateral – high knees – jumping above the mini hurdles, zig zag running through the boundary poles which is task 2 and then a ball is played to player No.1 from another player (No.2) 10 meters in front of him which is task 3. The task will be completed after player's, No.1, action which should be a reactive control and a ball kicking at the right or left mini goal, that player No.2 commands to.</p>	

Stage 5: Game Scenarios

We arrange the cones, as shown beside

AIM:
 20X20 m square with a player (defender, No.1) in one corner and an attacker in the opposite corner. We mark two 1m goals in the other unused corners. The defending player starts with a ball and pass it into the attacker. The attacker can score in either goal, defender must stop the attacker, if they win the ball back they become the attacker and can score a point. Once play has concluded, attacker and defender switch lines.

Drill continues with the same flow for 5-10 goals.

Stage 5: High Speed Running

We arrange the cones as shown beside.

AIM:
 The player sprints forward with full speed following the figure of the cones. At the end of each figure he returns at the initial point with same speed and takes a shot on the goal. He repeats the same pattern one more time and then starts the next one following the same flow for all RSA (1,2,3,4) twice. At the end of each RSA kicking drill, he rests for 20 sec before starts the next one.

Total Distance: 130m
 Total Time: N/A
 Recovery Time: 20" after each rep
 No. of Reps: 2 for each pattern
 Total distance covered: 260m

Table 3: Illustrative examples of each stage.

References
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