

ACL Rehabilitation Guide

A criteria driven ACL rehabilitation protocol and guide for both clinicians and people who have undergone a surgical reconstruction of the Anterior Cruciate Ligament (ACL).

Author: Randall Cooper



ACL Rehab: Randall Cooper's Criteria Driven Protocol



-   PHASE: **1** Recovery from surgery
-   PHASE: **2** Strength and neuromuscular control
-   PHASE: **3** Running, agility and landings
-   PHASE: **4** Return to sport
-   PHASE: **5** Prevent re-injury



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About Author

Randall Cooper



Randall Cooper is an experienced sports physio who consults at the Olympic Park Sports Medicine Centre in Melbourne, and is a fellow of the Australian College of Physiotherapists.

Randall is a former Olympic and AFL (Hawthorn FC) physiotherapist, but works with people of all abilities. He has published studies in international sports medicine journals, contributed to leading texts, and presented on many sports medicine related topics at major conferences and in the media.

Randall is the founder and director of sports and massage cream company Premax, and designer of the Cooper Knee Alignment Sleeve.

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Introduction

ACL Rehabilitation Protocol

The ACL rehabilitation protocol featured in this eBook is a guide for both clinicians and people who have undergone a surgical reconstruction of the Anterior Cruciate Ligament (ACL).

You move through the ACL protocol at your own pace, and let the criteria govern how quickly you go, not a pre-determined timeline.

Here are a few tips on how to progress through an ACL rehab protocol with minimal problems:

- Get the knee straight early (within the first 2-3 weeks), and keep it straight. Flexion can progress gradually.
- Use knee pain and knee swelling as a guide. If either or both are increasing, the knee isn't tolerating what you're doing to it.
- Technique is everything. Compensation patterns develop after an ACL tear, so focusing on correct muscle and movement/biomechanical patterns is paramount.
- Build high impact forces gradually. The articular structures in the knee joint will take time to adapt to a resumption of running, jumping and landing.
- Complete your ACL rehabilitation. Once people are back running with no knee pain it's easy to think that it's all done. But the last 1/3 of the protocol is the most important – to help reduce the chance of re-injury, increase the chance of a successful return to sport, and possibly to reduce the likelihood of osteoarthritis down the track.

As much as possible outcome measures that are evidence-based have been used, and only tests that can be performed with simple and inexpensive equipment have been included.

Clinicians should use a clinical reasoning approach in prescribing an exercise rehabilitation program and management advice for each phase. This ACL protocol briefly suggests typical exercises for each phase, but programs should always be individualised.

The ACL rehab protocol is broken down into 5 phases, and there's a list of goals and outcome measures that need to be satisfied at the end of each phase to move onto the next one.

The five phases are:

- **Phase 1: Recovery from surgery**
- **Phase 2: Strength & neuromuscular control**
- **Phase 3: Running, agility, and landings**
- **Phase 4: Return to sport**
- **Phase 5: Prevention of re-injury**



Phase 1

Recovery from Surgery

ACL reconstruction surgery is traumatic to the knee and a period of rest and recovery is required after the operation. Whilst it's tempting to want to get going and improve strength and range of motion, it's best to let the knee settle for the first 1-2 weeks with basic range exercises, quadriceps setting drills, ice and compression.

Typical exercises and management activities during this phase include regular icing of the knee and graft donor site (usually either the hamstrings or patella tendon), compression of the knee and lower limb, basic quadriceps setting exercises, and

gentle range of motion exercises to improve knee extension (straightening) and flexion (bending). Analgesics and other medications should only be used in consultation with your doctor.

The three most important goals of Phase 1 are:

1. **Get the knee straight (full extension)**
2. **Settle the swelling down to 'mild'**
3. **Get the quadriceps firing again**

PHASE: 1 Recovery from surgery

Most important goals ▶

Get knee straight

Settle the swelling

Get quadriceps firing

Phase 1

Outcome Measures and Goals

Outcome Measure	Test Description & Reference	Goal	✓
Passive Knee Extension	Supine with a long arm goniometer (Norkin & White, 1995). Bony landmarks: greater trochanter, the lateral femoral condyle, and the lateral malleolus.	0°	<input type="checkbox"/>
Passive Knee Flexion	Supine with a long arm goniometer (Norkin & White, 1995). Bony landmarks: greater trochanter, the lateral femoral condyle, and the lateral malleolus.	100°	<input type="checkbox"/>
Swelling/Effusion	Stroke Test (Sturgill et al, 2009) Zero: No wave produced on downstroke Trace: Small wave on medial side with downstroke 1+: Large bulge on medial side with downstroke 2+ Effusion spontaneously returns to medial side after upstroke 3+: So much fluid that it is not possible to move the effusion out of the medial aspect of the knee	Zero – 1+	<input type="checkbox"/>
Strength	Quadriceps lag test *variation (Stillman, 2004) With the patient sitting on the edge of a treatment bed, the therapist takes the relaxed knee into full passive extension. The patient is then required to maintain full active extension of the knee when the therapist removes support.	0° to 5° lag	<input type="checkbox"/>

Phase 2

Strength and Neuromuscular Control

Regaining muscle strength, balance, and basic co-ordination are the goals of Phase 2. This phase usually commences with easy body weight type exercises and progresses into a gym-based regime with a mixture of resistance, balance, and co-ordination.

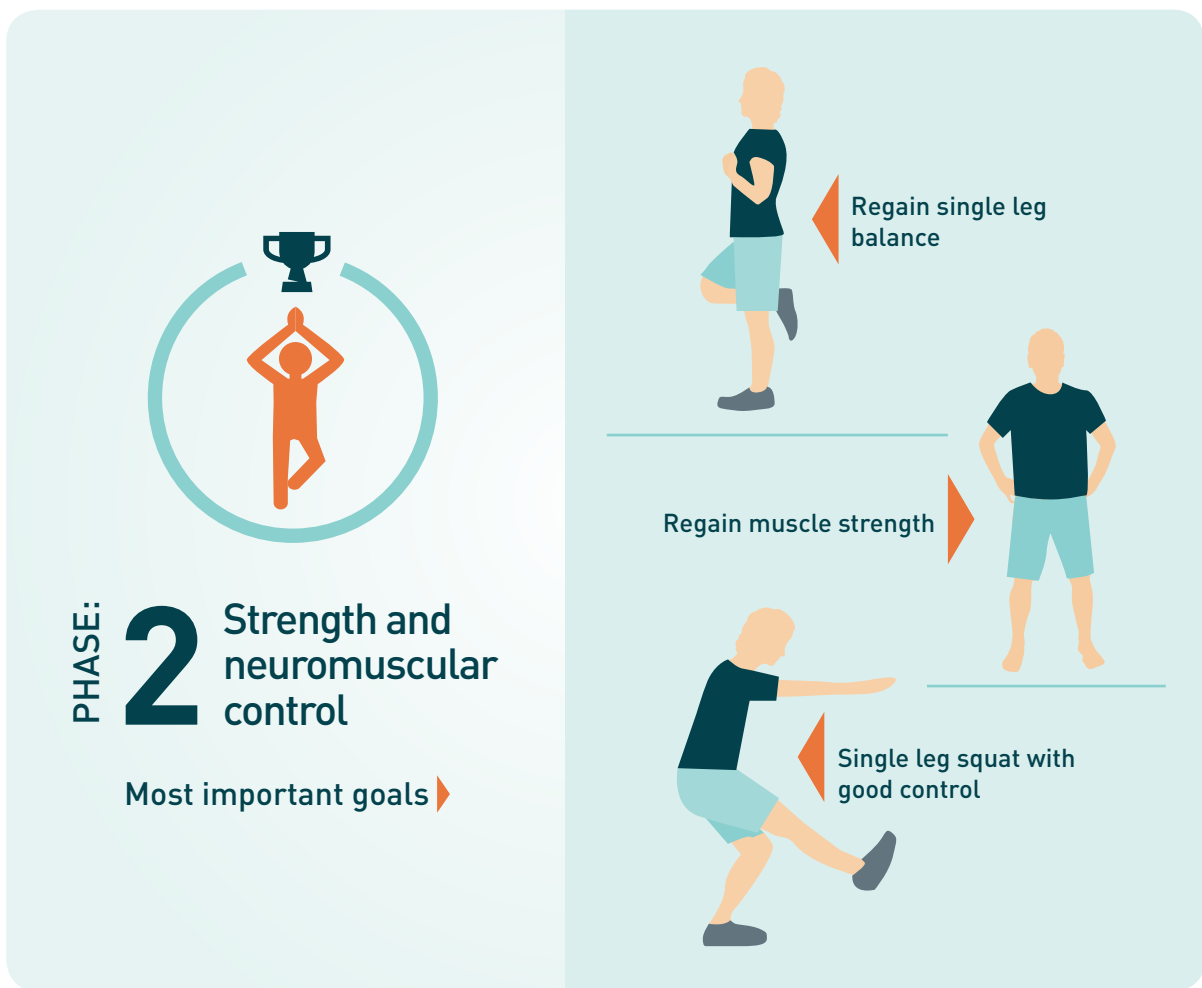
It's important for clinicians and patients to 'listen to the knee' during this phase and only progress as quickly as the knee will allow. Increase in pain and/or swelling are the two main symptoms that indicate that the knee is not tolerating the workload.

Typical exercises and management activities during this phase include lunges, step-ups, squats, bridging, calf raises, hip

abduction strengthening, core exercises, balance, gait re-education drills, and non-impact aerobic condition such as cycling, swimming, and walking. Some clinicians may start some introductory impact type activities such as walk-jogging or mini jumps during this phase, but the bulk of this type of training should be reserved for **Phase 3**.

The three most important goals of Phase 2 are:

1. **Regain most of your single leg balance**
2. **Regain most of your muscle strength**
3. **Single leg squat with good technique and alignment**



Phase 2

Outcome Measures and Goals

Outcome Measure	Test Description & Reference	Goal	✓
Passive Knee Extension	<p>Prone hang test (Sachs et al, 1989)</p> <p>Subjects lie prone on a treatment bed with the lower legs off the end allowing full passive knee extension. The heel height difference is measured (approx 1cm = 1°)</p>	Equal to the other side	<input type="checkbox"/>
Passive Knee Flexion	See description in Phase 1	125°+	<input type="checkbox"/>
Swelling/Effusion	See description in Phase 1	Zero	<input type="checkbox"/>
Functional Alignment Test	<p>Single leg squat test (Crossley et al, 2011)</p> <p>Subjects stand on one leg on a 20cm box with arms crossed. 5 x single leg squats are performed in a slow controlled manner (at a rate of 2 seconds per squat).</p> <p>The task is rated as “good”, “fair” or “poor”.</p> <p>For a subject to be rated “good”;</p> <ul style="list-style-type: none"> - Maintain balance - Perform the movement smoothly - Squat must be to at least 60 degrees - No trunk movement (lateral deviation, rotation, lateral flexion, forward flexion) - No pelvic movement (shunt or lateral deviation, rotation, or tilt) - No hip adduction or internal rotation - No knee valgus - Centre of knee remains over centre of foot 	“Good”	<input type="checkbox"/>
Single Leg Bridges	<p>Single leg bridge test variation (Freckleton et al, 2013)</p> <p>Subjects lie supine on the floor with one heel on a box or plinth at 60cm high. The knee of the test leg is slightly bent at 20° and opposite leg is bent to 90° hip and knee flexion with their arms crossed over chest. Subjects elevate the hips as high as possible and the assessor places a hand at this height. Repeat this action as many times as possible touching the assessors hand each time. The test concludes when the subject is unable to bridge to the original height (assessors hand).</p>	→85% compared with other side	<input type="checkbox"/>

Phase 2

Outcome Measures and Goals

Outcome Measure	Test Description & Reference	Goal	✓
Calf Raises	<p>Single leg calf raises</p> <p>Subjects stand on one foot on the edge of the step and perform a calf raise through full range of motion. Calf raises are performed at 1 repetition every 2 seconds. The test concludes when subjects are unable to move through full range or slow below the cadence outlined above.</p>	<p>→85% compared with other side</p> <p>(Hurdle requirement = 15 repetitions)</p>	<input type="checkbox"/>
Side Bridge Endurance Test	<p>Side bridge test (McGill et al, 1999)</p> <p>Subjects lie on an exercise mat on their side with legs extended. The top foot is placed in front on the lower foot, then subjects lift their hips off the mat to maintain a straight line over their full body length for as long as able. The test (time) ends when the hips return to the mat.</p>	<p>→85% compared with other side</p> <p>(Hurdle requirement = 30 seconds)</p>	<input type="checkbox"/>
Single Leg Press	<p>1RM Single Leg Press</p> <p>This test can be performed in most commercial gymnasiums that have an incline leg press. Please ensure an appropriate warm up.</p> <p>Seat position is at 90 degrees to the slide, and the foot should be placed so that the hip is flexed to 90 degrees. A valid repetition is where the weight is lowered to a depth of 90 degrees knee flexion and then extended back to full knee extension.</p>	<p>1.5 x Body Weight (sled + weight)</p>	<input type="checkbox"/>
Balance	<p>Unipedal stance test (Springer et al, 2007)</p> <p>Subjects stand on one leg with other leg raised and arms crossed over the chest. The assessor uses a stopwatch to time how long stance is maintained on one leg with a) eyes open, and b) eyes closed.</p> <p>Time ends when;</p> <ul style="list-style-type: none"> - Arms are used (uncrossed) - Use of the raised foot (touches down or other leg) - Movement of the stance foot - 45 secs has elapsed (maximum time) - Eyes opened on eyes closed trials 	<p>A (eyes open) 43 seconds</p> <p>B (eyes closed) 9 seconds</p> <p>(Normative data for 18-39 year olds)</p>	<input type="checkbox"/>

Phase 3

Running, Agility, and Landings

Phase 3 of this ACL rehab program sees a return to running, agility, jumping and hopping, as well as the continuation of a gym based strength and neuromuscular program.

The knee should be free of swelling and pain during this phase, and an emphasis is placed on correct technique particularly for deceleration tasks such as landing from a jump. It's important to perfect landing and pivoting biomechanics before progressing back to sport (Phase 4).

Exercises and activities in Phase 3 typically include agility drills such as slalom running, shuttle runs, and ladder drills. Jumping and hopping exercises usually start with drills such as scissor jumps and single hops and progress to box jumps and single leg landings with perturbations.

It's important that there is some rest and recovery time during this phase as many of the exercises and activities require eccentric muscle activity. Clinicians should watch for signs of overload of the patellofemoral complex in particular.

The three most important goals of Phase 3 are:

1. **Score 'excellent' on a jump-rebound task**
2. **Progress successfully through an agility program**
3. **Regain full strength and balance**



Phase 3

Outcome Measures and Goals

Outcome Measure	Test Description & Reference	Goal	✓
Single Hop Test	<p>Single leg hop test (Reid et al, 2007)</p> <p>Subjects stand on one leg and hop as far forward as possible and land on the same leg. The distance is recorded with a tape measure which is fixed to the ground.</p> <p>Two valid hops are performed.</p> <p>A limb symmetry index is calculated by dividing the mean distance (in cms) of the involved limb by the mean distance of the non involved limb then multiplying by 100.</p>	→90% compared with other side	<input type="checkbox"/>
Triple Cross Over Hop Test	<p>Triple Cross Over Hop Test (Reid et al, 2007)</p> <p>This test is performed on a course consisting of a 15cm marking strip on the floor which is 6m long. Subjects are required to hop three consecutive times on one foot, crossing the strip on each hop. The total distance is measured.</p> <p>Two valid hops are performed.</p> <p>A limb symmetry index is calculated by dividing the mean distance (in cms) of the involved limb by the mean distance of the non involved limb then multiplying by 100.</p>	→90% compared with other side	<input type="checkbox"/>
Modified Landing Error Scoring System	<p>Landing Error Scoring System (LESS) (Padua et al, 2009)</p> <p>Subjects jump off a 30cm high box onto the ground (at a distance from the box of 50% of their height) and immediately jump vertically upward as high a possible. The subject performs this task multiple times until the assessor has observed and marked all items/errors on the criteria.</p> <p>A visual or video analysis can be performed using the following criteria:</p> <p>Sagittal (Side) View</p> <ul style="list-style-type: none"> Hip flexion angle at contact – hips are flexed Yes=0, No=1 Trunk flexion angle at contact – trunk in front of hips Yes=0, No=1 Knee flexion angle at contact – greater than 30 degrees Yes=0, No=1 Ankle plantar flexion angle at contact – toe to heel Yes=0, No=1 Hip flexion at max knee flexion angle – greater than at contact Yes=0, No=1 Trunk flexion at max knee flexion – trunk in front of the hips Yes=0, No=1 Knee flexion displacement – greater than 30 degrees Yes=0, No=1 Sagittal plane joint displacement Large motion (soft)=0, Average=1, Small motion (loud/stiff)=2 	<p>Excellent</p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Soft <input type="checkbox"/></p> <p>Average <input type="checkbox"/></p> <p>Stiff <input type="checkbox"/></p>	<input type="checkbox"/>

Outcome Measure	Test Description & Reference	Goal	✓
Modified Landing Error Scoring System	<p>Coronal (Frontal) View</p> <ul style="list-style-type: none"> Lateral (side) trunk flexion at contact – trunk is flexed Yes=0, No=1 Knee valgus angle at contact – knees over the midfoot Yes=0, No=1 Knee valgus displacement – knees inside of large toe Yes=1, No=0 Foot position at contact – toes pointing out greater than 30 degrees Yes=1, No=0 Foot position at contact - toes pointing out less than 30 degrees Yes=1, No=0 Stance width at contact - less than shoulder width Yes=1, No=0 Stance width at contact - greater than shoulder width Yes=1, No=0 Initial foot contact - symmetric Yes=0, No=1 Overall impression – Excellent=0, Average=1, Poor=2 <p>Stratification of an individual's jump performances are represented with the following scale:</p> <ul style="list-style-type: none"> Excellent (0-3) Good (4-5) Moderate (6) Poor (7 or greater) 	<p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Y <input type="checkbox"/> N <input type="checkbox"/></p> <p>Excellent <input type="checkbox"/> Average <input type="checkbox"/> Poor <input type="checkbox"/></p> <p>TOTAL:</p>	<input type="checkbox"/>
Single Leg Press	<p>1RM Single Leg Press</p> <p>This test can be performed in most commercial gymnasiums that have an incline leg press. Please ensure an appropriate warm up.</p> <p>Seat position is at 90 degrees to the slide, and the foot should be placed so that the hip is flexed to 90 degrees. A valid repetition is where the weight is lowered to a depth of 90 degrees knee flexion and then extended back to full knee extension.</p>	<p>1.8 x Body Weight (sled + weight)</p>	<input type="checkbox"/>
Balance	<p>Star Excursion Balance Test (Gribble et al, 2012)</p> <p>The star excursion balance test (SEBT) is performed in the anterior, posterolateral, and posteromedial directions. If unfamiliar with the SEBT, watch the following video link: http://www.youtube.com/watch?v=QQPUdZYkII8</p> <p>A composite score for all 3 directions is obtained for each leg. A limb symmetry index is then calculated by dividing the mean distance (in cms) of the involved limb by the mean distance of the noninvolved limb then multiplying by 100.</p>	<p>→95% compared with other side</p>	<input type="checkbox"/>

Phase 4

Return to Sport

Phase 4 ACL rehab should be highly individualised, and exercises and training activities that are usual for the athlete when not injured should be integrated into their regime.

Focus should not only be on getting the knee ready for sport, but the whole person. The knee needs to be stable and strong, with optimal neuromuscular patterning and biomechanics. But the athlete needs to be confident and mentally ready to return to sport, and this will come from the repetition of successful training and match play situations.

A background of strength, balance, landing, and agility work needs to be done during this phase (and continue on into Phase 5 – Prevention of Re-injury), but the emphasis of Phase 4 ACL rehab is on progressive training, from restricted to unrestricted, and an eventual return to competition when ready.

So when are people ready to return to sport after an ACL reconstruction?

It's a difficult question to answer, and research projects are currently being conducted in various locations around the world hoping to provide some better evidence and guidance on the topic. But for me, I'm happy to allow people back to sport if they have satisfied 3 key criteria:

1. **Successful completion of the Melbourne Return to Sport Score (→95)**
2. **The athlete is comfortable, confident, and eager to return to sport**
3. **An ACL injury prevention program is discussed, implemented, and continued whilst the athlete is participating in sport**



Phase 4

Melbourne Return to Sport Score

The Melbourne Return to Sport Score (MRSS) is an assessment tool for returning to sport following anterior cruciate ligament reconstruction.

There are three components to the test:

- a) **Clinical Examination (25 marks)**
- b) **IKDC Subjective Knee Evaluation (25 marks)**
- c) **Functional Testing (50 marks)**

People receive a score out of 100, and pilot data suggests that a score of greater than 95 indicates a greater chance of returning to pre-injury sports and in the short term, predicts a quicker return to form.

All tests in the MRSS other than the Lachman's test, pivot shift test, IKDC, and the single leg squats to fatigue test have been described in previous chapters on ACL Rehab Phases 1-3. The single leg squats to fatigue test is described in the relevant sections.

PHASE: 4 Return to sport

MELBOURNE RETURN TO SPORT SCORE	
Clinical examination	/25
IKDC Subjective Knee Evaluation	/25
Functional Testing	/50

Phase 4

Melbourne Return to Sport Scoring Sheet

Part A: Stability, Swelling, & Range (see pg. 17)

Item	Result	Score	
Effusion		/5	
Stability		/10	
Flexion		/5	
Extension		/5	Converted
		/25	/25

Part B: IKDC Subjective Knee Evaluation Form (see pg. 18)

Item	Raw Score	Converted
IKDC	/100	/25

Part C: Functional Testing (see pg. 21)

Item	Result	Score	
Balance		/10	
Single Hop		/5	
Triple Hop		/5	
Jump/land		/25	
SL Squats		/5	Converted
		/50	/50

Final Score

Final Score	/100

Phase 4

Functional Testing Sheet

Star Excursion Balance Test

	Right	Left	LSI	Points
Anterior			%	/5
Posteromedial				
Posterolateral			LSI	Points
Total			%	/5

Single Hop Test

	Right	Left		
Trial 1	cm	cm		
Trial 2	cm	cm	LSI	Points
Mean	cm	cm	%	/5

Triple Cross Over Hop Test

	Right	Left		
Trial 1	cm	cm		
Trial 2	cm	cm	LSI	Points
Mean	cm	cm	%	/5

Abridged LESS: Jump-Land-Rebound Score

Item	Score	
Knee valgus at contact	/5	
Knee flexion →30 degrees	/5	
Trunk stability at contact	/5	
Foot contact – symmetrical/30°	/5	
Overall impression	/5	Points
Total	/25	/25

Single Leg Squats to Fatigue (90° knee flexion)

	Right	Left	LSI	Points
Trial 1			%	/5

Phase 4

Melbourne Return to Sport Score Criteria

The following section explains the criteria for each of the Melbourne Return to Sport Score (MRSS) outcome measures.

Part A: Stability, Swelling, & Range

Test	Outcome	Points Awarded
Effusion	Absent	5 points
	Present	0 points
Lachman's test	Nil	5 points
	Mild	3 points
	Moderate-severe	0 points
Pivot shift test	Nil	5 points
	Grade I	3 points
	Grade II	1 points
	Grade III-IV	0 points
Flexion	0-5 degrees deficit	5 points
	5-20 degrees deficit	3 points
	20+ degrees deficit	0 points
Extension (Prone Hang Test)	0-2cm deficit	5 points
	2-5cm deficit	3 points
	5cm+ deficit	0 points
		/25 points

Presence of effusion test

- absent
- present

Lachman's test

- Nil: no difference to the uninvolved side
- Mild: 0 to 5 mm laxity (greater than the uninvolved side)
- Moderate: 6 to 10 mm laxity (greater than the uninvolved side)
- Severe: 11 to 15 mm laxity (greater than the uninvolved side)

Pivot shift test

- I : Gentle twisting slide with tibia twisting internally maximally;
- II : Clunk with tibia neutral, negative when tibia externally rotated;
- III: Painless glide for examiner and patient;
- IV : Jamming and plowing, impingement;

Phase 4

Melbourne Return to Sport Score Criteria

Part B: IKDC Subjective Knee Evaluation Form

Test	Outcome	Points Awarded
IKDC	Raw score /100 Divide by 4	/25 points

Your Full Name _____

Today's Date: ____/____/____ Date of Injury: ____/____/____
Day Month Year Day Month Year

SYMPTOMS*:

*Grade symptoms at the highest activity level at which you think you could function without significant symptoms, even if you are not actually performing activities at this level.

1. What is the highest level of activity that you can perform without significant knee pain?

- 4 Very strenuous activities like jumping or pivoting as in basketball or soccer
- 3 Strenuous activities like heavy physical work, skiing or tennis
- 2 Moderate activities like moderate physical work, running or jogging
- 1 Light activities like walking, housework or yard work
- 0 Unable to perform any of the above activities due to knee pain

2. During the past 4 weeks, or since your injury, how often have you had pain?

- Never | 0 1 2 3 4 5 6 7 8 9 10 | Constant
 |

3. If you have pain, how severe is it?

- No pain | 0 1 2 3 4 5 6 7 8 9 10 | Worst pain
 | imaginable

4. During the past 4 weeks, or since your injury, how stiff or swollen was your knee?

- 4 Not at all
- 3 Mildly
- 2 Moderately
- 1 Very
- 0 Extremely

5. What is the highest level of activity you can perform without significant swelling in your knee?

- 4 Very strenuous activities like jumping or pivoting as in basketball or soccer
- 3 Strenuous activities like heavy physical work, skiing or tennis
- 2 Moderate activities like moderate physical work, running or jogging
- 1 Light activities like walking, housework, or yard work
- 0 Unable to perform any of the above activities due to knee swelling

6. During the past 4 weeks, or since your injury, did your knee lock or catch?

- 0 Yes
- 1 No

7. What is the highest level of activity you can perform without significant giving way in your knee?

- 4 Very strenuous activities like jumping or pivoting as in basketball or soccer
- 3 Strenuous activities like heavy physical work, skiing or tennis
- 2 Moderate activities like moderate physical work, running or jogging
- 1 Light activities like walking, housework or yard work
- 0 Unable to perform any of the above activities due to giving way of the knee

Phase 4

Melbourne Return to Sport Score Criteria

SPORTS ACTIVITIES:

8. What is the highest level of activity you can participate in on a regular basis?
- 4 Very strenuous activities like jumping or pivoting as in basketball or soccer
 - 3 Strenuous activities like heavy physical work, skiing or tennis
 - 2 Moderate activities like moderate physical work, running or jogging
 - 1 Light activities like walking, housework or yard work
 - 0 Unable to perform any of the above activities due to knee

9. How does your knee affect your ability to:

		Not difficult at all	Minimally difficult	Moderately Difficult	Extremely difficult	Unable to do
a.	Go up stairs	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
b.	Go down stairs	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
c.	Kneel on the front of your knee	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
d.	Squat	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
e.	Sit with your knee bent	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
f.	Rise from a chair	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
g.	Run straight ahead	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
h.	Jump and land on your involved leg	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>
i.	Stop and start quickly	4 <input type="checkbox"/>	3 <input type="checkbox"/>	2 <input type="checkbox"/>	1 <input type="checkbox"/>	0 <input type="checkbox"/>

FUNCTION:

10. How would you rate the function of your knee on a scale of 0 to 10 with 10 being normal, excellent function and 0 being the inability to perform any of your usual daily activities which may include sports?

FUNCTION PRIOR TO YOUR KNEE INJURY:

Couldn't perform daily activities	0	1	2	3	4	5	6	7	8	9	10	No limitation in daily activities
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

CURRENT FUNCTION OF YOUR KNEE:

Can't perform daily activities	0	1	2	3	4	5	6	7	8	9	10	No limitation in daily activities
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Scoring Instructions for the 2000 IKDC Subjective Knee Evaluation Form

Phase 4

Melbourne Return to Sport Score Criteria

Several methods of scoring the IKDC Subjective Knee Evaluation Form were investigated. The results indicated that summing the scores for each item performed as well as more sophisticated scoring methods.

The responses to each item are scored using an ordinal method such that a score of 0 is given to responses that represent the lowest level of function or highest level of symptoms. For example, item 1, which is related to the highest level of activity without significant pain is scored by assigning a score of 0 to the response "Unable to perform any of the above activities due to knee pain" and a score of 4 to the response "Very strenuous activities like jumping or pivoting as in basketball or soccer". For item 2, which is related to the frequency of pain over the past 4 weeks, the responses are reverse-scored such that "Constant" is assigned a score of 0 and "Never" is assigned a score of 10. Similarly, for item 3, the responses are reverse-scored such that "Worst pain imaginable" is assigned a score of 0 and "No pain" is assigned a score of 10. Note: previous versions of the form had a minimum item score of 1 (for example, ranging from 1 to 11). In the most recent version, all items now have a minimum score of 0 (for example, 0 to 10). To score these prior versions, you would need to transform each item to the scaling for the current version.

The IKDC Subjective Knee Evaluation Form is scored by summing the scores for the individual items and then transforming the score to a scale that ranges from 0 to 100. Note: The response to item 10a "Function Prior to Knee Injury" is not included in the overall score. To score the current form of the IKDC, simply add the score for each item (the small number by each item checked) and divide by the maximum possible score which is 87:

$$\text{IKDC Score} = \left[\frac{\text{Sum of Items Score}}{\text{Maximum Possible Score}} \right] \times 100$$

Thus, for the current version, if the sum of scores for the 18 items is 45 and the patient responded to all the items, the IKDC

Score would be calculated as follows:

$$\text{IKDC Score} = \left[\frac{45}{87} \right] \times 100$$

$$\text{IKDC Score} = 51.7$$

The transformed score is interpreted as a measure of function such that higher scores represent higher levels of function and lower levels of symptoms. A score of 100 is interpreted to mean no limitation with activities of daily living or sports activities and the absence of symptoms.

The IKDC Subjective Knee Form score can be calculated when there are responses to at least 90% of the items (i.e. when responses have been provided for at least 16 items). In the original scoring instructions for the IKDC Subjective Knee Form, missing values are replaced by the average score of the items that have been answered. However, this method could slightly over- or under-estimate the score depending on the maximum value of the missing item(s) (2, 5 or 11 points). Therefore, in the revised scoring procedure for the current version of a form with up to two missing values, the IKDC Subjective Knee Form Score is calculated as (sum of the completed items) / (maximum possible sum of the completed items) * 100. This method of scoring the IKDC Subjective Knee Form is more accurate than the original scoring method.

A scoring spreadsheet is also available at: www.sportsmed.org/research/index.asp This spreadsheet uses the current form scores and the revised scoring method for calculating scores with missing values.

Phase 4

Melbourne Return to Sport Score Criteria

Part C: Functional Testing

Test	Outcome	Points Awarded
Balance		/10
Single Hop		/5
Triple Hop		/5
Abr LESS: Jump/land		/25
Single Leg Squats		/5
		/50 points

Functional Assessment Scoring:

The hop tests, single leg squats, and star excursion balance test will be calculated as a limb symmetry index by dividing the mean distance (cms), or repetitions of the involved limb by the mean of the non involved limb, and multiply by 100. Each criteria of the abridged Landing Error Scoring System (LESS) - jump/land/rebound task will be assessed on a 0/5 point scale:

	Points Awarded
Excellent / NAD	5 points
Mild, Moderate, or Severe Error	0 points

For the tests that use the limb symmetry index, the following criteria will apply:

Limb Symmetry Index (dominant leg)	Points Awarded	Limb Symmetry Index (non dominant leg)	Points Awarded
97-105	10/10 or 5/5	95-103	10/10 or 5/5
90-96 / 105-110	8/10 or 4/5	85-94 / 103-110	8/10 or 4/5
80-89 / 110-120	6/10 or 3/5	75-84 / 110-120	6/10 or 3/5
70-79 / 120-130	4/10 or 2/5	65-74 / 120-130	4/10 or 2/5
60-69 / 130-140	2/10 or 1/5	55-64 / 130-140	2/10 or 1/5
<60 / 140+	0 points	<55 / 140+	0 points

The single leg squats to fatigue test:

Subjects are seated on the edge of a treatment plinth with hips and knees at 90°. Arms are to be crossed over the chest. On one leg, subjects are asked to raise to a fully extended knee as many times as possible at a tempo of 2 seconds up, and 2 seconds down. The test is complete when subjects are unable to complete any further squats, or the tempo or form is incorrect. The maximum number of squats are recorded for each leg.

Phase 5

Prevention of Re-Injury

Most ACL injuries and re-injuries occur in non-contact situations with either a cutting movement or one-legged landing being the main mechanisms of injury. ACL injury prevention programs aim to train safer neuromuscular patterns during these tasks.

An ACL injury prevention program should be considered for people who are rehabilitating from an ACL injury and/or reconstruction, and for people who participate in sports with a high incidence of ACL injury such as Australian Rules Football, Basketball, Netball, Soccer, and Alpine Skiing. It should be noted however that the most common mechanism for an ACL injury during skiing is when the skier is falling backwards, in deep knee flexion, and the ski rotates.

Females have a higher risk of ACL injury (x2-8) compared to males who undertake the same sport or activity. Anatomical differences may play a role with females having a smaller size

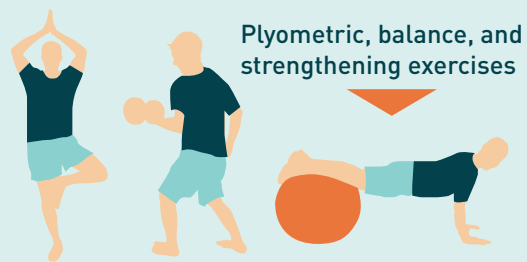
and shape of the intercondylar notch, a wider pelvis and greater Q-angle, and greater ligament laxity. Hormonal differences have also been suggested, in particular oestrogen levels. Females are more vulnerable to an ACL injury in their pre-ovulatory phase.

One further reason females may have a higher risk of ACL injury is due to neuromuscular factors. Females rely more on their quadriceps than males, responding to anterior tibial translation with a quadriceps contraction rather than hamstrings. Females also land with less hip and knee flexion than males and this has been termed 'ligament dominance'. These neuromuscular factors are the most modifiable out of the risk factors, and form the basis of exercises advocated for ACL injury prevention.



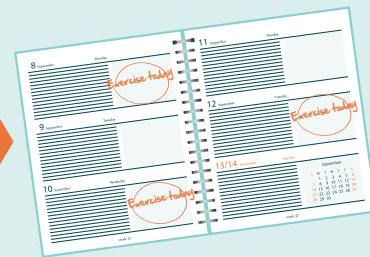
PHASE: 5 Prevent re-injury

Successful ACL injury prevention programs include ▶



Plyometric, balance, and strengthening exercises

A program performed more than once per week ▶



WEEK 1	WEEK 2	WEEK 3
✓	✓	✓
WEEK 4	WEEK 5	WEEK 6
✓	✓	✓

◀ A program that continues for at least 6 weeks

Phase 5

Prevention of Re-Injury

ACL injury prevention programs aim to improve the neuromuscular control of individuals during standing, cutting, and landing tasks. A meta-analysis of 6 published studies showed a positive effect of these programs with the key components of the program being:

- **Plyometric, balance, and strengthening exercises**
- **That the program must be performed more than once per week**
- **That the program continues for at least 6 weeks.**

Two popular injury prevention programs that include exercises to help reduce ACL injuries are available on the web. Links and brief descriptions are as follows:

1. The PEP program

Link: <http://www.aclprevent.com/pepprogram.htm>

The PEP (Prevent injury, Enhance Performance) Program is a highly specific 15-minute training session that replaces the

traditional warm-up. It was developed by a team of physicians, physical therapists, athletic trainers and coaches, and has funding support from the Amateur Athletic Foundation of Los Angeles (AAF). The program's main focus is educating players on strategies to avoid injury and includes specific exercises targeting problems as identified in previous research studies.

2. The FIFA 11+

Link: <http://f-marc.com/11plus/index.html>

The 11+ is divided into three parts: it starts off with running exercises (part I), moves on to six exercises with three levels of increasing difficulty to improve strength, balance, muscle control and core stability (part II), and concludes with further running exercises (part III). The different levels of difficulty increase the programme's effectiveness and allow coaches and players to individually adapt the programme. "The 11+" takes approx. 20 minutes to complete and replaces the usual warm-up before training. Prior to playing a match, only the running exercises are performed, for about ten minutes.

PHASE: 5 Prevent re-injury

Women are up to eight times more likely to sustain an ACL injury than men who undertake the same sport or activity.

Q&A with Randall Cooper



Randall is a leading Australian Sports Physiotherapist with an expertise in knee injuries and rehabilitation. Randall consults from the Olympic Park Sports Medicine Centre in

Melbourne and is the author of this Criteria Driven ACL Rehabilitation Guide. He is also the designer of the Cooper Knee Sleeve by Thermoskin and founder of sports and massage cream company Premax.

1. Tell us about your specialisation in knees, and patients you see?

My interest in knee injuries goes all the way back to when I needed an ACL reconstruction following a skiing injury at 16 years of age. Following my initial Bachelor degree in Physiotherapy I went on to do a Masters degree by research investigating different methods of rehabilitation following ACL reconstruction. On the clinical side, I have worked closely with skiing and Australian rules football athletes for many years with knee and ACL injuries being common. In 2008 I became a Specialist Sports Physiotherapist (as awarded by the Australian College of Physiotherapists) with a sub specialty in knees. The majority of patients I now see have problems associated with their knee, and I assist people of all athletic abilities.

2. There are many ACL Rehabilitation Protocols available, what inspired you to write this guide and what makes it different?

Everyone is different, and every person who has an ACL reconstruction has a different journey. Some people have trouble getting their swelling settled, others regaining range of motion, or rebuilding hamstring strength. The list goes on. A universal, one-size-fits all list of exercises doesn't account for these differences in recovery or take into a consideration the sports, goals, and abilities for each person. People assisting with the rehabilitation of a person following ACL reconstruction need to take all these factors into account and customise a rehab program accordingly. I've put together a protocol that allows individual variation, but highlights important milestones and goals along the way.

3. What kind of success have you seen following this ACL rehabilitation guide?

I feel the protocol is good for a couple of reasons. First of all, it allows health practitioners to individualise the program as mentioned previously. Second, and probably most importantly, the protocol gives the patient a very clear understanding of what is required along the way and at the end. Knowing that hopping, jumping, and single leg squats to fatigue will be assessed and compared with their un-injured leg before they are allowed to return to sport is a powerful motivator to complete the process.

4. You also designed the Thermoskin Cooper Knee Sleeve, tell us how that came about?

Improving the dynamic alignment and control of the knee is a major component of the management of most knee injuries. There is also evidence to suggest that poor dynamic knee alignment may increase the risk of a knee injury in the first instance too. As a result I spend much of my working day as a physiotherapist working on optimising knee alignment with my patients, but I can't be there all the time. To help consistently remind people about good alignment and activating the right muscles, I thought a purposely-designed knee sleeve could really help and the Cooper Knee Alignment sleeve was born.

5. Why did you decide to partner with Thermoskin?

Thermoskin is a great Australian brand, and I have used and recommended Thermoskin products for many years. Many of my colleagues have too. I have always found Thermoskin products to be effective and of high quality. Feedback from patients has always been excellent. I had also known some of the senior staff at Thermoskin for many years, and we started a conversation about the knee sleeve and took it from there.

Q&A Continued onto next page...

Q&A with Randall Cooper

6. How does the Thermoskin Cooper Knee Sleeve work?

The knee sleeve helps improve dynamic alignment and control of the knee. The circular compression of the sleeve provides additional sensory input back to the nervous system, improving movement awareness. There is an anti valgus strap, which gently tightens when people go into a knock-kneed (valgus) position helping people recognize this vulnerable position. Two elastic slings run around each side of the knee cap giving additional sensory input on the tracking of the knee cap, and silicone dots are on the inner of the sleeve which overlay and help stimulate activation of the medial quadriceps and medial hamstring muscle groups, both very important for stability and control of the knee.



Anti-valgus strap



Patella sling



Silicone dots

7. Who would you recommend the Thermoskin Cooper Knee Sleeve to?

I'd recommend the knee sleeve to almost anyone who is having trouble with their knee or knees. The sleeve provides a gentle reminder to improve knee alignment and muscle activation, and can be used for a variety of conditions including patellofemoral (kneecap) problems, post ACL reconstruction or knee arthroscopy, following knee ligament injuries, or for people with early degenerative changes such as osteoarthritis. The sleeve could also be used in uninjured people who have poor knee biomechanics and are looking to improve their strength and alignment to help prevent a knee injury.

8. What's the best advice you can offer to people to protect their knees from injury?

First of all, keep your legs strong. Strong muscles, in particular the quadriceps, hamstrings and gluteals will help reduce impact forces in the knees. Secondly, work on balance and movement control. Having good movement awareness, postural control and dynamic alignment is a key component of the prevention of knee injuries and problems.

Optimising movement and control of the knee



“The Cooper Knee Alignment Sleeve by Thermoskin® has been designed to enhance knee alignment, proprioception and muscle control whilst performing sport and exercise.”

Randall Cooper

Sports Physiotherapist and Designer of the Cooper Knee Sleeve by Thermoskin



Anti-valgus strap to assist with knee alignment.



Patella sling for enhanced patella tracking.



Silicone dots to boost activation of the inner quads and hamstrings.

Compression for increased movement awareness.

*Patent pending.

View the product video by scanning the QR code or visiting <http://www.youtube.com/user/ThermoskinSupportTV>



Freecall 1800 188 019 or email enquiries@upi.com.au

www.thermoskin.com

Available: Nationally: iHealthsphere.com.au



THERMOSKIN®

Disclaimer: The information contained in this document is a source of information and an education resource for health professionals and people who have sustained a knee problem. The content contained in this document is not intended to be used for diagnosis or treatment of knee conditions, nor should the content be used as a substitute for care or consultation from health professionals. All treatment decisions should be made in consultation with a health professional.

Bibliography

References

Crossley, Kay M., et al. "Performance on the single-leg squat task indicates hip abductor muscle function." *The American journal of sports medicine* 39.4 (2011): 866-873.

Freckleton, Grant, Jill Cook, and Tania Pizzari. "The predictive validity of a single leg bridge test for hamstring injuries in Australian Rules Football Players." *British journal of sports medicine* (2013): bjsports-2013.

Gribble, Phillip A., Jay Hertel, and Phil Plisky. "Using the Star Excursion Balance Test to assess dynamic postural-control deficits and outcomes in lower extremity injury: a literature and systematic review." *Journal of athletic training* 47.3 (2012): 339-357.

McGill, Stuart M., Aaron Childs, and Craig Liebenson. "Endurance times for low back stabilization exercises: clinical targets for testing and training from a normal database." *Archives of physical medicine and rehabilitation* 80.8 (1999): 941-944.

Norkin, Cynthia C., and D. C. White. "Measurement of joint: A guide to goniometry." (1995): 88-9.

Padua, Darin A., et al. "The Landing Error Scoring System (LESS) Is a Valid and Reliable Clinical Assessment Tool of Jump-Landing Biomechanics The JUMP-ACL Study." *The American journal of sports medicine* 37.10 (2009): 1996-2002.

Reid, Andrea, et al. "Hop testing provides a reliable and valid outcome measure during rehabilitation after anterior cruciate ligament reconstruction." *Physical therapy* 87.3 (2007): 337-349.

Sachs, Raymond A., et al. "Patellofemoral problems after anterior cruciate ligament reconstruction." *The American journal of sports medicine* 17.6 (1989): 760-765.

Stillman, Barry C. "Physiological quadriceps lag: its nature and clinical significance." *Australian Journal of Physiotherapy* 50.4 (2004): 237-241.

Sturgill, Lynne Patterson, et al. "Interrater reliability of a clinical scale to assess knee joint effusion." *Journal of orthopaedic & sports physical therapy* 39.12 (2009): 845-849.

Springer, Barbara A., et al. "Normative values for the unipedal stance test with eyes open and closed." *Journal of Geriatric Physical Therapy* 30.1 (2007): 8-15.