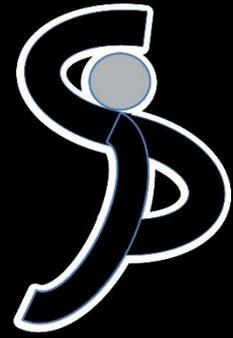


CALLAHAN
PHYSIOTHERAPY



ACL Rehab



ACL Rehab: An Overview

This ACL rehabilitation protocol is a guide for 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.

A clinical reasoning approach is used to prescribing your exercise rehabilitation program and management advice for each phase. Meaning your rehabilitation program will be tailored to suit your individual needs.

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.

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**

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

1. Get the **knee straight** early (within the first 2-3 weeks), and keep it straight. Flexion can progress gradually.
2. **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.
3. **Technique is everything.** Compensation patterns develop after an ACL tear, so focusing on correct muscle and movement/biomechanical patterns is paramount.
4. **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.
5. **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.

Good luck!

Phase 1

Recovery from Surgery

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.

Your surgeon will have an individual preference on weight-bearing, crutches, and bracing, so make sure you follow their advice.

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: Measures and Goals

| Outcome Measure | Test Description & Reference | Goal |
|--------------------------------------|---|--|
| <p>Passive Knee Extension</p> | <p>Straighten Knee</p> |  <p>0° - Fully Straight</p> |
| <p>Passive Knee Flexion</p> | <p>Bend Knee</p> |  <p>100° Bent</p> |
| <p>Swelling/Effusion</p> | <p><u>Stroke test</u></p> <p>Trace: Small wave on medial side with downstroke</p> <p>1+: Large bulge on medial side with downstroke</p> <p>2+: Effusion spontaneously returns to medial side after upstroke</p> <p>3+: So much fluid that it is not possible to move the effusion out of the medial aspect of the knee</p> | <p>Zero to 1+</p> |
| <p>Strength</p> | <p>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.</p> |  <p>0° to 5° lag - hold as straight as possible</p> |

- Pass these tests to move onto phase 2.

Phase 2

Strength and Neuromuscular Control

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 exercises.

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: Measures and Goals

| Outcome Measure | Test Description & Reference | Goal |
|---|---|---|
| Passive Knee Extension | <p><u>Prone hang test</u></p> <p>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 |
| Passive Knee Flexion | <p><i>See description in Phase 1</i></p> | 125°+ |
| Swelling/Effusion | <p><i>See description in Phase 1</i></p> | Zero |
| Functional Alignment Test | <p><u>Single leg squat test</u></p> <p>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). 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”  Poor |
| Single Leg Bridges | <p><u>Single leg bridge test</u></p> <p>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 |

| | | |
|--|---|---|
| <p>Calf Raises</p> | <p><u>Single leg calf raises</u></p> <p>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 (Hurdle requirement = 15 repetitions)</p> |
| <p>Side Bridge Endurance Test</p> | <p><u>Side bridge test</u></p> <p>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 (Hurdle requirement = 30 seconds)</p> |
| <p>Single Leg Press</p> | <p><u>1RM Single Leg Press</u> (http://www.rowingaustralia.com.au/docs/protocol_strength-and-power.pdf 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> |
| <p>Balance</p> | <p><u>Unipedal stance test</u></p> <p>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><i>(Normative data for 18-39 year olds)</i></p> |

- Pass these tests to move onto phase 3.

Phase 3

Running, Agility and Landing

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 swelling and pain free 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.

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. Be sure to watch for signs of overload of the patellofemoral joint complex, below the knee cap.

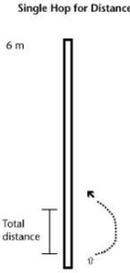
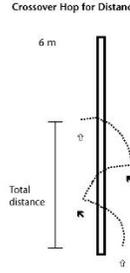
The three most important goals of Phase 3 are:

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

The following hurdle criteria must be met before Phase 3 testing is conducted (see Phase 1 & 2 for test descriptions):

- Full range of motion (prone hang test and knee flexion)
- No effusion/swelling (stroke test)
- A “good” rating on the Single Leg Squat Test (Crossley et al, 2011)
- No side to side difference for the Single Leg Bridge Test, Single Leg Calf Raises, and Side Bridge Endurance Test

| Outcome Measure | Test Description & Reference | Goal |
|--|--|--|
| <p>Single Hop Test</p> | <p><u>Single leg hop test</u></p> <p>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>A limb symmetry index is 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>Single Hop for Distance</p> <p>6 m</p> <p>Total distance</p> <p>>90% compared with other side Normative Values: 176.6cm SD=27.8 (dominant), 172.19cm SD=26.13 (non-dominant)</p> |
| <p>Triple Cross Over Hop Test</p> | <p><u>Triple Cross Over Hop Test</u></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>A limb symmetry index is 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>Crossover Hop for Distance</p> <p>6 m</p> <p>Total distance</p> <p>>90% compared with other side</p> |
| <p>Landing Error Scoring System</p> | <p>Landing Error Scoring System (LESS)</p> <p>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 as possible. The subject performs this task multiple times until the assessor has observed and marked all items/errors on the criteria.</p> |  |

| | | |
|--|--|---|
| | <p>You will be marked as:</p> <ul style="list-style-type: none"> • Excellent (0-3) • Good (4-5) • Moderate (6) • Poor (7 or greater) <p>Assessment observed from the front and the side and is based on your hip, knee, foot and trunk positions, at different times of the jumping activity.</p> |  <p>Excellent</p> |
| <p>Single Leg Press</p> | <p><i>See description in Phase 2</i></p> | <p>1.8 x Body Weight (sled + weight)</p> |
| <p>Single leg vertical Jump</p> | <p>Jump off one leg as high as you can Get three trials</p> | <p>Normative Data: 21.22cm (SD=5.17) (dominant) 20.85 (SD=5.07) non-dominant</p> |
| <p>Balance</p> | <p><u>Star Excursion Balance Test</u></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=OQPUdZYkI18</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> |

- Pass these tests to move onto phase 4.

Phase 4

Return to Sport

Return to Sport

Phase 4 ACL rehab should be highly individualised, and exercises and training activities that are usual for you 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 you also need to be confident and mentally ready to return to sport, and this will come from 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 you 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.

Here are the 3 criteria the developer of this rehab protocol, Randall Cooper, suggests;

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

There is some evidence to suggest that people who are under the age of 18 years should wait until 12 months post surgery before they return to sport, otherwise if you can pass the above tests then you are in a good position to get back to playing whatever the time frame post surgery.

Phase 5

Prevention of Re-Injury

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.

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 estrogen 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.

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**
- **And 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.

This ACL rehabilitation protocol was developed by Randall Cooper, Specialist Sports Physio from Melbourne. It is also available on his blog: <https://swollenkneedotme.wordpress.com/>

All Images were sourced from relevant searches on google images.