



ACL Injury - Rehabilitation

General Principles

Reduction of swelling:

Following injury this is the first step – a swollen knee restricts movement and has an inhibitory effect on the muscles. You can do lots of exercises but will not progress while the knee is swollen and prolonged swelling can lead to adhesion formation with resultant stiffness.

Range of movement: Any restriction of movement will affect return to normal function. The longer a knee remains restricted, the harder it is to regain the movement. The old adage 'if you don't use it, you lose it' certainly does apply to joint movement therefore gradually increasing range, once inflammation has settled down, is important. Swelling in a static knee is the environment in which adhesions form within the joint – if these are allowed to develop and mature they can become very tough and difficult to stretch out at a later date.

Strength: Muscles are your joints' first line of protection, so good muscle control is important if joint stability is to be achieved. Strengthening exercises have to be progressed steadily and must be staged so

that they do not aggravate the knee or put you at risk of further injury by being too aggressive too soon.

The quadriceps, on the front of your thigh, is a large group of muscles responsible for straightening the knee, and for holding you upright against gravity. They also act as decelerators when doing running and jumping type activities. They are a powerful group of muscles and are important for normal function of the joint. This is putting things rather simply but basic exercises to maintain some level of activity in the muscles are needed from day 1 after injury. This may amount to nothing more than damage limitation as far as muscle wasting is concerned but nevertheless is valuable. The type of exercise performed for the quadriceps is relevant therefore please read the section explaining the 'open and closed kinetic chain' concept.

The hamstrings, on the back of your thigh, are another large group of muscles responsible primarily for bending the knee (they also pass across the back of the hip and help to extend it). The hamstring muscles cross the back of the knee and attach to

the bones just below the joint, they have a tendency to hold the tibia back in relation to the femur and this reinforces the action of the ACL. It therefore follows that strong hamstring muscles will help to stabilise the knee in the absence of the ACL.

The calf, hip and trunk muscles can also become weak very quickly if you have a period of inactivity. It is important to re-establish strength in all muscle groups for the return of normal function.

Proprioception: This refers to the body's ability to produce balanced, co-ordinated movement, to have spatial awareness and to react to altering conditions. Ligaments and other soft tissues around the joint have special nerve endings within them, which are responsible for telling the brain where you are in space – if you hold your arm out to the side, you know exactly where it is even though you are not looking at it – it is these proprioceptive nerve endings which are responsible for providing this information.

If you damage a major ligament then information from that source will be lost – specific exercises which encourage balance, co-ordination and reaction will help to sharpen up the responses in the surrounding structures, thus minimising the effect of the lost ligament.

Kinetic Chain Exercise: The terminology used here has been hijacked from engineering but in our context the 'kinetic chain' is referring to a series of joints, specifically the hip, knee and ankle. The kinetic chain is referred to as being either 'open' or 'closed' during various exercises and this does have significant relevance for ACL injured or deficient knees.

In an '**open**' chain exercise the terminal part of the chain (the ankle or foot) does not meet any resistance and is free to move in space, thus movement is only occurring at one joint and, essentially, only one muscle group is working.



open chain hamstring exercise



open chain quad exercise

In both of these examples the foot is free, actual joint movement is only occurring at the knee and consequently only one primary muscle group is active.

Conversely, during a '**closed**' chain exercise the foot is in contact with some form of resistance, be it the floor, the pedal of a bike or the plate of a leg-press machine. This means that movement is occurring at all three joints and there is 'co-contraction' of various muscle

groups including both the quads and hamstrings.

Examples:



In both of these examples you can see that movement is occurring at the hip, the knee and the ankle. During the step-up the hamstring muscles work to extend the hip and the quads work to extend the knee.

Why is this significant?

We have already discussed the fact that the hamstring muscles pass down the back of the thigh and attach to the top of the lower leg bones, thus tending to hold the tibia back in relation to the femur. Conversely, the quadriceps pass down the front of the thigh and have a tendency to pull the tibia forwards in relation to the femur, particularly in the range of movement from 30° of flexion to fully straight.

In normal circumstances this 'tibial translation' is controlled by the cruciate ligaments. If the ACL is damaged, there is nothing to prevent excessive anterior (forward) translation of the tibia when the quadriceps work in isolation (open chain exercise). Working the quadriceps in conjunction with the hamstrings, as in closed chain exercise, allows good strengthening without causing undue translation.

Why is excessive translation undesirable?

All joints have a certain amount of play in them, this is termed 'accessory movement' and is usually controlled by ligaments and other soft tissues around the joint. Damage to these structures can result in gross accessory movement accompanying voluntary movement and this often causes the feeling of instability or giving way. Over a prolonged period of time these secondary restraints in the joint can become stretched.

Continuous increased movement can also lead to secondary damage to other structures which have undue stress placed upon them. The menisci in the knee become more vulnerable to injury and the articular (hyaline or joint surface cartilage) may become damaged by increased wear. ACL deficient knees are likely to have increased anterior tibial translation and increased rotation (twisting) in the knee and it is commonly during activities which involve twisting that instability is felt.

Progressing your exercises

If you and your consultant have decided that surgery is the right option then you will be required to reach stage 2 prior to your operation.

If you are going to follow a conservative path, then you must work through all the stages. Your physiotherapist is there to help you and guide you through the programme and will advise on progression at the appropriate times.

As your swelling settles down it is important to gradually increase your exercises and work through the following stages, but progression from one stage to the next will be dependant on you rather than a definite time scale. You should be able to complete exercises at each level without experiencing pain or instability before you move on – this is particularly important when moving from stages 3 to 4 and from 4 to 5. If you experience instability or giving way you may have tried to progress too soon.

Stage 1:

The early acute days – follow the PRICE regime – move on to stage 2 when swelling has settled down.

Stage 2:

- Regain full range of movement equal to your other uninjured leg.
- Basic strengthening exercises – The emphasis is on simple closed chain exercises and specific hamstring exercises. Everything should be in a straight line – no twisting, turning or change of direction activities at this stage.
- Walking re-education – weaning off crutches, eradication of limp.

We have already mentioned that the hamstring muscles tend to reinforce the action of the ACL, it therefore follows that if you have a damaged or ruptured ACL, strong hamstring muscles are vital.

Suggested simple exercise progression which can be done at home:

These will help to bend the knee and work the hamstrings:



Knee bending – assist with other leg. Use other leg to gradually increase bend.



Knee bend – no assistance Progress by adding a small ankle weight.



Gently take buttocks towards heels – hold this position, relax and repeat.

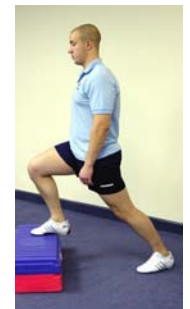
The aim is to achieve full movement – both flexion (bend) and extension (straightness) equal to your other leg. Strength and co-ordination (balance) are also important.

Quadriceps and general leg exercises:

These should be done slowly and carefully so that the movement is controlled. You can also practise standing and balancing on one leg but be sure to have something to hold near by in case you wobble.



Small dips on both legs



Lunging on step



Step-ups on bottom stair



gentle leg press



hamstring curls



knees straight - lift hips

Most of these are easy to practice at home. It is better to do a few exercises regularly throughout the day, rather than try to do too many in one go – 10 minutes four or five times a day is better than 45 minutes at once, at this stage.

You do not want to aggravate the knee or cause it to swell. Begin with just a few repetitions of each exercise and gradually increase, providing the knee does not react. When you have full range of movement, can walk without a limp and are confident on stairs you can move to stage 3.

Stage 3:

- Introduce balance and co-ordination work
- Progress strengthening exercises – single leg work, cycling, trampette, gym work

Examples:



single leg balance & dips



balance on rubber cushion



increase height of step



balance & gentle jogging on trampette



knee extension with cliniband resistance



half squats on gymball

Begin using the aerobic equipment – the static bicycle, the rower, the cross-trainer, the stepper – these are all closed chain activities and should not be a problem. Start by doing just a few minutes on a variety of different exercises rather than spending a long time on just a single piece of equipment, this way you will work more muscles in a greater variety of ways. You can also do some walking on the treadmill – gradually increase speed and distance but do not run yet.

If you want to lift fixed weights then you can do hamstring curls and leg press but avoid the quads bench (leg extensions in a sitting position) – these are open chain exercises. Begin lifting low weights and doing more repetitions, rather than trying to lift maximum weight, of course you can do any upper body training you wish.



exercises on rocker board for balance & proprioception



walking on treadmill



stepper

At this stage you could start to attend your local gym. The advantage of the gym is that it is a controlled environment and all exercises are 'straight line' in nature – there is no twisting or turning involved.

Stage 4:

- Your physiotherapist will advise when you are ready to move onto this more advanced stage.
- Introduce change of direction activities.
- Brisk walk / jogging programme



side stepping



sideways movement



angled lunging

Now is the time to try some running, you must start gently and build up gradually. Begin by increasing the speed of the treadmill up to a gentle jog, just for a couple of minutes, in the middle of a brisk walk (perhaps walk for 5 minutes, jog for 2 and then back down to a walk again). Providing you do not have any adverse reaction you can steadily increase the jogging time and decrease the walk.

Do not increase the speed beyond a gentle jog until you are completely comfortable. The treadmill is the ideal place to begin a running programme because the surface is obviously flat, not too hard and the environment is controlled.

You can progress to running outside when you are confident but no cross country or accompanying football yet!!

Stage 5:

This is the final stage before you return to full sports training.

Activities must be increased to include acceleration, deceleration and cutting movements. Jumping and hopping activities, including plyometric training, can be started.

It is also important that you try to simulate some of the movements involved in your own particular sport – if you play soccer you can start dribbling and passing a ball, if you are a basketball player you can start dribbling the ball, initially in a straight line and then between cones – eventually add a jump shot at the end.

If you are attending a gym you may choose to join a training class at this stage circuit training, step aerobics etc. will all help to improve strength, agility, endurance and general fitness. Be sure that the instructor knows that you are recovering from injury and you may not complete all activities.



multi-directional hopping



multi-directional jumping



jumping, rebounding & landing

When you can successfully complete these activities without any symptoms and you feel confident that your leg is as strong as your other leg you can go back to your sports training. If you play a contact sport you will require a period of non-contact training before the contact element is added.

If at any time you have a period of relative inactivity such as a long vacation, then it is important for you to fully regain any loss of strength before you play competitive sport again.

Good luck, keep your leg strong and hopefully you will not have further problems.

If you have experienced episodes of instability or feelings of 'giving way' at any stage then you should go back a stage.



carioca running



figure 8 running