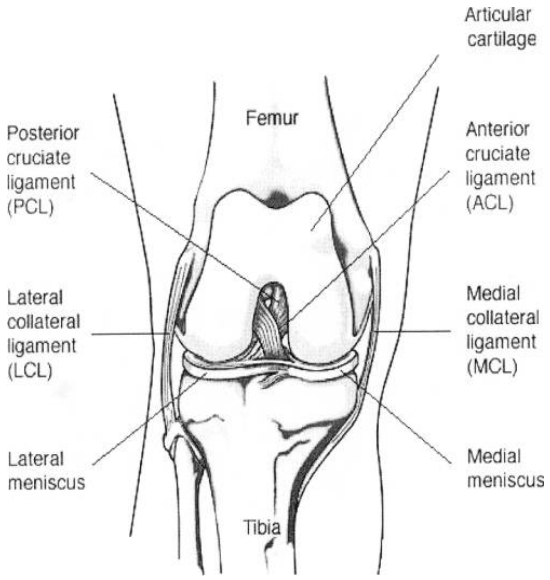
Anterior cruciate ligament (ACL) reconstruction

This leaflet outlines advice and exercises following ACL reconstruction – an operation to replace your torn anterior cruciate ligament and restore stability to your knee joint.



About the ACL and why surgery is sometimes necessary

The ACL is one of the main stabilising ligaments of the knee and is commonly torn in sporting activities, particularly football, netball and skiing. It also provides significant feedback information to the muscles surrounding the knee, allowing coordinated activities. Your ACL cannot repair itself, so when it has been torn (ruptured) it often leaves you with a permanently loose and unstable knee. Sometimes, patients may experience pain or an ongoing lack of confidence (known as 'proprioception') in their knee.

Not everyone who has an ACL rupture ends up with a problem. The older and less sporty you are, the less likely it is to go on causing trouble. Nevertheless, the majority of people with a rupture of their ligament will notice looseness and will probably wish to have something done about it.

The operation is recommended to overcome clear episodes of giving way, which should allow a return to work and sport. There is increasing evidence that by stabilising the knee after such ligament injury, we can protect it from further damage – such as cartilage trouble and possibly osteoarthritis in the future. This is particularly so in children and teenagers but less certain in later adulthood.

Reasons for not operating

An operation is not recommended if there is any active infection in or around the knee or when there is a lot of other disease, such as arthritis within the joint. In such cases, any benefit from an operation might be slight. Reconstructing the ACL is not going to cure arthritis or necessarily

make it feel more comfortable, unless there is a very pronounced instability element to the problem.

Although the operation can be done on the day of the initial injury, if it is performed in the 'early' weeks following the injury it can, in some cases, lead to pain and stiffness. So we often recommend letting the joint 'settle down' for **at least six or eight weeks after the accident**, before going ahead with the procedure. This period of 'pre-operative rehabilitation' can often benefit from a course of physiotherapy, which can help to restore a full range of movement and restore some muscle strength and confidence.

What are the alternatives to surgery?

Stability of the knee can be improved with intensive physiotherapy exercises – not just for strengthening the muscles but more importantly, for improving balance and the ability to 'hold on to your knee'. Some people seem to gain more benefit from physiotherapy than others and in many cases we will have tried this non-operative treatment before recommending the operation.

Bracing is another way of stabilising the knee without surgery and there are purpose-made ACL braces that protect the joint and which can be very valuable during certain sports. The braces are rather too cumbersome to wear day to day and in some contact sports the braces are banned for obvious reasons. But in sports such as tennis and squash, and for skiing and snowboarding, they can be particularly useful if these are the occasions that the knee tends to give out. Wearing a brace does not appear to weaken the knee.

The use of slim Neoprene sleeves appears to improve patients balancing skills very slightly and some people use them but their benefit is very difficult to actually measure.

Leaving a knee unstable and taking part in a lot of twisting and turning sport will increase the risk of further damage to the knee – with cartilage injuries being the commonest problem – and this in turn will probably hasten the onset of osteoarthritis. Nevertheless, it has never been proven that surgery protects the joint from arthritis and even with an operation the long-term outlook for the knee is guarded.

Success rates of surgery

Reconstruction with the techniques described below is well tried and tested now. Ninety percent of patients have a successful reconstruction, in that their instability symptoms will be reduced and their ability to get back to more vigorous activities enhanced. However, only 10% of our patients actually say that the knee feels 'as good as new'. It is therefore common that although there will be an improvement, it may not feel quite as good as it was before the injury. Ten percent of people fail to get significant benefit from the operation for a variety of reasons.

Sometimes, this is due to a complication, such as infection or other problems that lead to stiffening of the knee, although this is extremely unusual. Some patients' grafts fail to 'take' for reasons that are not immediately clear to us, and the knee joint remains unstable.

A few patients have a nicely 'stabilised' knee but lose confidence despite lengthy rehabilitation. They sometimes do not actually feel as if they have been benefited and do not go back to levels of activity they might have wished.

Not everyone with a stable knee gets back to the level of sport they did before, and indeed, a lot of patients find the injury followed by a reconstruction puts them off going back to the original sport that they injured the joint in.

More specific complications are outlined below:

The operation

The operation takes approximately one hour and is done with the aid of the arthroscope (keyhole surgery).

In bone-patellar-bone reconstruction, a 1cm wide strip of tendon with a little bit of bone at each end is taken from your kneecap tendon and fashioned into a suitable graft. This is passed through the knee and fixed with screws top and bottom to exactly match the original position of the ruptured ligament. Occasionally, there are remnants of the original ligament still there, some of which can be preserved, but they make little contribution to the procedure and usually, most of the remnants have to be removed in order to see the correct positions for the new graft.

The scar required for the middle third patellar tendon is approximately 4 inches long and is vertical, running straight up the centre of the kneecap tendon.

In hamstring reconstruction, a 1.5 inch incision (cut) is made over the upper inner part of the shin and two hamstring tendons are retrieved and folded over to form a four strand graft. This is then threaded through in the same way as described above, across the joint and fixed in place with a variety of screws, pins and / or staples to provide a secure fix.

In both cases, the keyhole camera is used to check the rest of the joint for signs of wear and tear and to attend to any cartilage trouble, either with a stitch or by removing a torn fragment.

The wounds are normally closed with stitches and the leg bandaged with simple dressings and wool and crepe bandage. A lightweight cricket pad splint is occasionally used to help stabilise the joint until your muscle function comes back.

If you undergo the repair of a large meniscal tear at the same time as your ligament reconstruction, you may need to wear a brace after your operation. This brace will limit your knee movement for a few weeks, in order to protect the meniscus cartilage.

After the operation

In the first day or two after surgery, the knee will be sore and you will require some form of regular painkiller, which will be advised and dispensed for you. Pain varies and some people find the procedure more troublesome than others, but during this time, you will be encouraged to get mobile with the physiotherapists and start your rehabilitation programme.

You will be able to weight bear on your leg and will be mobilised as soon as you are safe. You will usually be discharged from hospital the day after the operation. If performed early in the morning, you may even be discharged the same day, i.e. as a day case procedure.

Further physiotherapy and post-operative issues are dealt with below.

Side effects

We define a side effect as an inevitable consequence of the operation but not necessarily of any benefit to you – the obvious example being the scar. Other common side effects that occur after knee ligament surgery are:

- **Sensory disturbance** around the scar on the inner side of the knee, which can be permanent. This is a slight numbness, typically in a ‘D’ shaped area, which may stretch for several inches below the scar on the inner side of the leg. It does not lead to any long-term

weakness or progressive damage but can be a permanent feature.

- **Scar tenderness** is not uncommon, particularly in patellar tendon reconstructions, which can lead to long-term difficulty in prolonged kneeling. If your job involves kneeling, we would probably advise you not to have this particular variety of the operation.
- It is normal for the knee to be slightly **swollen and stiff** for several weeks afterwards
- Kneecap **clicking and crunching** is not an uncommon complaint for weeks, if not months, after the procedure, until the muscle tone has recovered fully.
- **Proprioception.** Despite functional stability, the operated knee may not 'feel right' for a long time. Regular balance exercises and wearing a tubigrip occasionally may help this.

Complications

Fortunately, serious complications are rare.

- **Infection** can occur (less than 1 in 100) and although this potentially could damage the result of the procedure, we have had very few incidents of this occurring. What is a little more common is superficial infection in the wound. If it becomes pink, inflamed and sore it will normally respond to antibiotics either prescribed by the hospital or by your GP. This complication tends to occur in the first two weeks after the operation and is unusual (less than 5%), but normally fully responds to treatment.
- **Deep vein thrombosis (DVT) – 'clot in the leg'.** 'Blood thinning agents' are not actually recommended routinely but we do use compression stockings and recommend early active mobilisation following your operation. The most important issues are to tell us beforehand if you are on any medication like the contraceptive pill or even more importantly, if you have ever had a clot before – which puts you at particular risk. Even with all the treatment, clots cannot be absolutely guaranteed not to occur. The usual symptom of a clot is a painful, swollen calf within a few days to a few weeks after your operation. **It is a potentially fatal condition because the clot, if left untreated, can move into the lungs.** We have never had a case of fatal embolus but we have had cases of thrombosis that have required patients to come back for assessment, diagnosis and treatment with blood thinning medication. In these rare cases, the result of the operation has not been affected, but of course recovery has been slower and rehabilitation has been interfered with for several weeks.
  If you do get a painful, swollen calf in the weeks following your surgery, please contact us as an emergency or attend the Emergency Department (A&E), rather than wait for the next outpatient appointment.
- **Pain.** Persistent pain can occur after any knee operation. Most post-operative pain settles down in 48 hours and then an ache continues for a few weeks after exertion. Some people seem to struggle with pain for a little longer for reasons which are not always associated with infection or other obvious cause. There are very rare abnormal pain responses (regional pain syndrome) that can cause this and these have their own specific treatments. If pain becomes a problem, please let us know. In the vast majority of cases, the pain is manageable with simple medication alone.
- **Early graft failure.** The graft is at its weakest in the first few weeks after your surgery – just as you are beginning to gain your confidence on the leg – and there have been cases when accidents have caused the new graft to rupture. This is very unusual and probably in most cases unavoidable in the circumstances, but it is important to take the advice that we are

giving you regarding gradual progression and follow the advice of the physiotherapists. **Do not get back to football after a few weeks**, even if your knee feels up to it!

Very rare and extreme risks

All surgery is potentially fatal, although the incidence of a serious rare anaesthetic complication leading to death is probably one in tens of thousands, and we have never had a death due to this procedure in our unit in 15 years of knee ligament surgery. However, it is beyond the scope of this document to identify all the most extreme (less than one in a thousand) risks that you might be prone to, but we will be very happy to discuss any worries about specific concerns and also about any family history or your own personal history of problems in the past which are much more relevant.

Follow up timeframes

- **7-10 days post op:** outpatient physiotherapy should start.
- **2 weeks post op:** suture removal by nurse at GP practice (some sutures may be dissolvable).
- **6 weeks post op:** ACL clinic appointment – with X-ray on arrival, unless already taken post-op in theatre.
- **12 weeks post op:** ACL clinic appointment – assess confidence in knee / strength / proprioceptive ability.
- **24 weeks post op:** ACL clinic appointment – with KOOS (Knee Osteoarthritis Outcome Score) / functional scores and discussion regarding return to sport.
- **52 weeks post op: ACL clinic appointment** – with KOOS/functional scores, discussion re outcome and future.

Outpatient physiotherapy

This usually starts **within the first 1-2 weeks** following surgery and should be arranged before discharge. You will be given exercises to do for this period between discharge and physiotherapy starting. Typical progress / targets:

Phase 1: Recovery from surgery (Week 1)

Goals:	*Outcome measures*
• Protect fixation and surrounding soft tissue. • Diminish swelling/inflammation. • Regain / maintain full knee extension / hyperextension passively and actively. • Regain active quadriceps and VMO control. • Restore patella mobility. • Restore normal gait pattern. • Patient education regarding rehabilitation process.	• Passive knee extension to zero degrees. • Passive knee flexion to 125 degrees. • Swelling – Grade 0-1 on sweep test. • Be able to perform SLR with minimal / no lag (0-5 degrees).

Phase 2: Strength and neuromuscular control

Patients and therapists should 'listen to the knee' and only progress things as quickly as the knee will allow. Increase in pain and / or swelling indicate that the knee is not tolerating the workload. **Please note:** Exercises will progress now but the graft is at its greatest risk of failure during this phase, as it is going through the process of revascularisation and remodelling.

Goals	*Function:*
• Wean off crutches if good SLR with no lag. • Eliminate any joint swelling. • Prevent any scar or graft site adhesions. • Prevent symptoms of anterior knee pain. • Maintain full knee extension / hyperextension. • Restore full ROM equal to other side. • Restore single leg proprioception / neuromuscular control. • Regain most of muscular strength. Maximise strength in a safe manner that does not overstress the graft. • Single leg squats with good technique and alignment. • Increase fitness and endurance. • Restore lower limb confidence and function. • Maintain flexibility.	• Start kneeling (on padded surface initially). • Return to sedentary jobs and driving when 'safe' and knee swelling down. • Return to physical work (light duties with limited walking initially). • Golf at the driving range permitted (chipping and putting practice) once off crutches with normal gait pattern. • Able to return to play golf if good control of knee and outcome measure met. • Able to return to cycling on road bike using low gears and avoid rugged terrain (at approx. 12 weeks, to allow for revascularisation and remodelling of the graft). • Swimming but no breaststroke until 12 weeks (to allow for revascularisation and remodelling of the graft). • Short haul flights allowed if essential (first 4- 6 weeks due to risk of blood clots. • Long and short haul flights without restrictions towards the end of this stage.
Outcome measures • Full knee extension / hyper-extension equal to other side. • Dry knee with no effusion. • Single leg squats with good technique and alignment.	*Supplementary outcome measures* These are recommended if the patient is returning to high level jumping, cutting and / or pivoting sports. These should however not cause a block to progressing to the next phase. • Single leg bridge > 85% compared with other side. • Single leg calf raises > 85% compared with other side. • Side bridge (plank) endurance test > 85% compared with other side Single leg squat > 85% compared with other side. • Balance one leg > 85% compared with other side. • 1 RM single leg press 1.5 x body weight. • 1 RM squat 1.5 x body weight.

Phase 3: Running, agility and landing

Emphasis is placed on correct technique particularly for deceleration tasks, e.g. landing from a jump. It is essential to master / perfect landing and pivoting biomechanics before progressing to the next phase. **Please note:** Some rest and recovery days should be incorporate into this phase to allow the knee to recover from the eccentric loading of many of the exercises. Ensure overloading of the patellofemoral joint does not occur.

Goals • Ensure no symptoms AKP due to increased load on knee. • Enhance lower limb confidence and function. • Start agility exercises. • Start running and gentle sports specific training. • Change of direction / agility training and modified game play can start and progress under physiotherapist supervision. • Increase speed of balance reactions and improve co-ordination. • Increase functional activities. • Maintain motivation. • Ensure excellent hopping performance and technique with no exacerbation of symptoms (single hop, triple hop, crossover hop and vertical hop > 75%contralateral leg (unless used for graft). • Prepare physical and psychological ability for complete return to sporting activity.	*Return to running criteria (straight line).* Normally somewhere between 8-16 weeks, dependent on progress and control. *Clinical* • Pain > 2/10 on VAS scale. • 95% limb symmetry on knee flexion ROM. • Full knee extension. • No effusion / swelling. *Strength* (evaluated by isometric or isokinetic testing) • Hamstring limb symmetry index Limb symmetry index (LSI) >70%. • Quads limb symmetry index (LSI) >70%. *Performance* • Hop tests (LSI) > 70%. • Able to achieve 30 single leg heel raise off a step taking 2 seconds to lift up and 2 seconds to drop down. Do not bounce. • Ability to achieve 20 single leg hamstring bridges taking 2 seconds to lift up and 2 seconds to lower. • Ability to stand on one leg for 15 seconds with eyes open and then eyes closed. • Ability to achieve 5 single leg squat to 70 degrees knee bend off 20 cm box keeping correct lower limb alignment. • Ability to achieve step up test for 3 x 1 minute at 180 beats per minute rate keeping correct lower limb alignment. • Ability to perform 12 single leg sit to stands from 90 degrees of knee flexion. • Return of confidence in knee. • If using a leg press. Ability to push x1 body weight for 10 reps. • Elite athletes or more experienced runners this should be 1.5 times body weight.

Outcome measures for Phase 3

- The following criteria must be met prior to further testing of outcome measures:
  - Full active ROM at the knee.
  - No effusion / swelling.
  - A 'good' rating on single leg squat test.
  - No difference in the single leg bridge test, single leg calf raise and side bridge / plank test.
- Single hop, triple hop. Triple cross over hop tests > 95% compared with other side (or equal to or greater than pre-op data for affected or unaffected limb).
- Side hop test (marks 40cms apart) > 95% compared with other side.
- Single leg squat. Hurdle requirement = >22 reps both legs.
- Star excursion test > 95% compared with the other side.
- Cooper and Hughes vestibular balance test:
  - A) One leg balance with small knee bend, hands on waist. At rate of 60 beats / min, turn head side to side for 15 secs without loss of balance or hands from waist.
  - B) One leg balance with small knee bend, hands on waist. At rate of 60 beats / min tilt head from floor to ceiling for 15 secs without loss of balance or hands from waist.

Supplementary outcome measures

These are recommended if the patient is returning to high level jumping, cutting and / or pivoting sports. However, these should not cause a block to progressing to the next phase.

- 1 RM single leg press 1.8 x body weight.
- 1 RM squat 1.8 x body weight.

Phase 4: Return to sport

The knee should be:

- Stable with no reported episodes of instability.
- Have optimal neuromuscular patterning and biomechanics.
- Pain free / virtually pain free.
- Dry, i.e. no swelling / discharge.

Goals	*Actions*
• To progress sport training and to develop strength and endurance levels to allow return to full sporting activity without problems. This takes time, especially to build up confidence to return to full contact activities. This will depend on type of sport and when the appropriate season is. • Strength and functional outcomes are > 90 % contralateral leg. • Functional hop tests are >90% contralateral leg (vertical and horizontal hop tests). • Symmetrical landing and take off (functional testing). • Star excursion test > 90% contralateral leg.	• Advise 3/12 of training to work on strength, stamina and confidence prior to return to sport. • A graduated return to a full game is advised.

• Enhance physical and psychological ability for complete return to sporting activities. • Increase patient awareness of when reaching 'fatigue' danger point. • Unrestricted confident function.	
Please note: A full return to sporting activity is generally not advised until one year post-operatively for adults and 18 months for adolescents and children, due to the increased risk of re-rupture of the graft prior to this (unless otherwise advised). Research has shown that the ACL graft can continue to remodel and strengthen for up to two years after surgery	

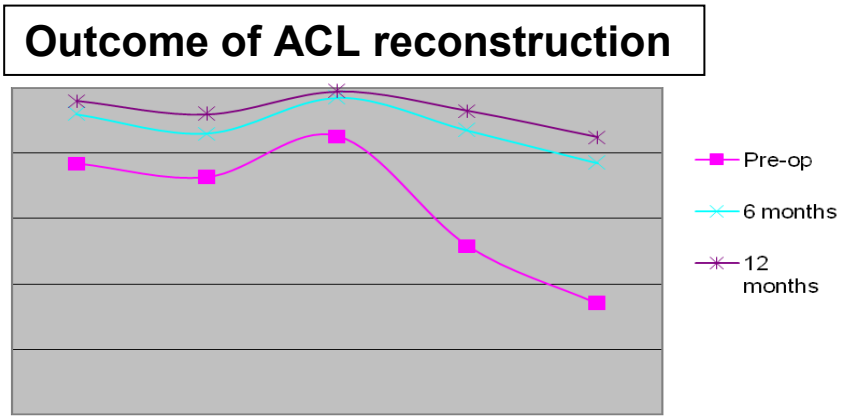
Phase 5: Prevention of re-injury

- Key components of an injury prevention programme should include:
  - Balance, strengthening and plyometric exercises
  - Should be performed for at least 10 minutes before every training session and game.
  - The programme should be on going and ideally more than once a week.
- Examples of injury prevention programmes are:
  - The FIFA 11+ warm up.
  - Activate injury prevention programme (rugby).
  - The PEP programme.
  - Sportsmetrics programme.
  - The KNEE programme (Netball, Australia).
  - The Footy First Programme (NFL).

Post-operative progress

As listed above, you will be reviewed at regular intervals in the 'Knee Injury Clinic' at the Royal Berkshire Hospital by a specialist physiotherapist, who will assess your progress. The most important component of your recovery is your regular attendance at physiotherapy classes, where you will be given strict instructions regarding appropriate exercises and the 'dos and don'ts'.

At certain points before and after your surgery, we will be going through one or two questionnaires with you to provide us with information about your functional improvement not only to make sure you are getting better but also to ensure that our surgery has been successful for our own records. A typical pattern of recovery for all patients operated on is shown in the graph (*right*). This illustrates that a 'full recovery' may take up to 12 months.



Long term outlook

As previously stated, 90% of people get benefit from the operation and are back doing the activities they wish between six and 12 months from the time of the operation – depending on their commitment and their level of sporting activity. The long-term stability of the knee once achieved, seems to last indefinitely with graft failure being unusual unless another specific injury occurs. Re-rupture of the original graft is relatively unusual. The normal reason for people coming back to the clinic is either a similar injury to the *other* knee (some people seem to be more prone to ACL rupture than others). Or, over 10-15 years after surgery, it is not unusual for the development of some osteoarthritis to occur. We are not sure whether this is inevitable in everyone who has had a ligament injury or whether surgery can delay this somewhat, but even with a successful stabilising operation, it is possible wear and tear arthritis will develop at some point in the future.

Further information sources

An immense amount of information is available on the Internet, but if you find something that is of interest or controversial and you wish to discuss it, we will be delighted to see it and add it to the list if we thought it was useful.

Here are a few you might find useful:

www.orthoassociates.com/ACL-Page.htm
www.yourmedicalsource.com/library/acltears/ACL-whatis.html
www.arthroscopy.com/sp5000.htm
www.genufix.com/ACL-inform.htm

Contact us

RBFT Physiotherapy Department
0118 322 7811 or 7812

Approved by the Knee Research and Audit Group (KRAG), Royal Berkshire Hospital, Reading. In accordance with 'Best practice for primary isolated ACL reconstruction', British Orthopaedic Association 2020.

To find out more about our Trust visit www.royalberkshire.nhs.uk

Please ask if you need this information in another language or format.

Debbie Burden, Orthopaedic Physiotherapy Specialist / Sean O'Leary FRCS (Trauma & Orthopaedic Surgeon), December 2021
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