

# Anterior Cruciate Ligament Reconstruction

## Patient information and Rehabilitation Guidelines

This section provides a summary of information relating to injury to the Anterior Cruciate Ligament, covering what it is, how it is injured and how it is reconstructed. A summary is given of the rehabilitation plan with its stages right up to returning to sport.

Full detail is contained in the rehabilitation and information booklet obtainable from Mr Spalding.

### 1. WHAT IS THE ACL ALL ABOUT?

#### Introduction

The anterior cruciate ligament (ACL) is one of the main restraining ligaments in the knee. It runs through the centre of the knee, from the back of the femur (thigh bone) to the front of the tibia (shin bone), and it acts as a link mechanism between the thigh and lower leg. (Fig 1)

The main function of the ACL is to stabilise the knee, especially during rotation, sidestepping, and pivoting movements.

This means that when the ACL is ruptured or torn, the tibia moves abnormally on the femur and comes out of joint, and the knee buckles. The main feeling is a sense of the knee giving way during twisting or pivoting movements, and a sense of not trusting the knee when turning.

It is usual to be able to return to walking and straight line running following a torn ACL but to not trust the knee on rough ground or twisting movements. All too often the diagnosis can be delayed because the knee may recover for straight line activities, giving a false sense of security, but there is no control when returning to pivoting sports.

And when the knee gives way, there is a risk of further damaging the other key structures in the knee – hence the importance of preventing re-injury by making an early diagnosis.

#### Mechanism of Injury

Typically, the ACL is injured in a non-contact, twisting movement involving rapid deceleration on the leg, or a sudden change of direction, such as during side stepping, pivoting or landing from a jump (Fig 2). Injuries are often associated with a popping sensation followed by swelling in the knee over the next few hours due to bleeding from the torn ligament.



Typical scenarios include a footballer or rugby player who catches his foot in the ground as he tries to change direction, a netball player who jumps and lands awkwardly twisting on their bent knee with their foot out to the side, and a skier who catches the ski at slow speed and twists their leg out to the side.



There are many other scenarios of course and depending on the exact mechanism it is also possible to damage the joint surfaces (articular cartilage), or the meniscus (footballer's cartilage).

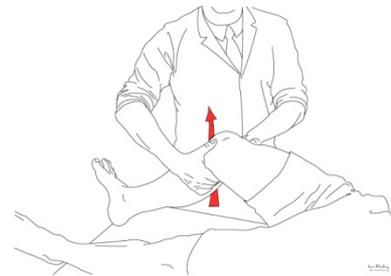


## Diagnosis

Injury to the ACL is diagnosed by detecting an increase in the forward movement of the tibia in relation to the femur. Normally such movement is prevented by the ACL. The examining doctor gently grasps the tibia and the femur and tries to detect the increased movement. (Fig)

Another of the tests is the Pivot Shift test (Fig), which gently reproduces the giving way sensation as the knee is slowly bent. Done carefully these are painless tests and can accurately diagnose a torn ligament.

Often the diagnosis can be made from the story – a pivoting twisting movement associated with a pop sensation and the feeling of immediately not trusting the knee. Others nearby may have heard a pop and thought the leg was broken. Early swelling is common and it is not usually possible to carry on playing - and any attempt to do so often results in the knee giving way again.



## The importance of the ACL

The importance of the ACL is that it is the main stabiliser of the knee and without it fast pivoting and twisting actions become difficult and result in giving way of the knee. It is hard to get back to pivoting type sports without a good ACL. In addition repeated buckling or giving way of the knee leads to secondary damage of the other important structures of the knee – namely the smooth bearing surface (articular cartilage) and the protective shim between the surfaces (meniscus or footballers cartilage).

Once these become damaged then there is much higher risk of later problems with the knee such as pain from wear and tear arthritis. Repeated giving way of the knee is therefore not good for the knee.



## Types of tears: functional or non-functional

Several different words are used to describe a torn ACL including ruptured, snapped, injured, torn and popped for example. Once injured, it can partially heal in some people and this may give sufficient restraint to return to non pivoting sports. In most however, the ligament will not heal tight enough to function for sports involving rapid change of direction.

The principle, therefore, is whether the cruciate ligament is functional or not functional in controlling stability in rotation activities. If the ligament is functional and the requirement to get back to fast pivoting sports is low, then surgery is not likely to be needed.

## Proprioception: The special function of the ACL

As well as providing a restraint to abnormal knee movement, the ACL gives important information to the muscles involved in the reflex control of knee movements. Nerve fibres give the knee a sense of position and movement and this sensory awareness is known as **proprioception**. It is a normal feature of all joints and helps to give us balance control and confidence in movements.

To some extent, this can be compensated for after ACL injury by special rehabilitation exercises for the hamstrings and quadriceps (thigh) muscles. However, the knee is a complex joint and muscle strength may not be enough alone for individuals who take part in pivoting type sports.

## Indications for reconstruction of the ACL

Surgical reconstruction is indicated in individuals who wish to return to pivoting type sports, and for those who have problems with giving way during day-to-day activities. We have previously outlined how repeated giving way of the knee may lead to damage of other structures within the knee and it is this repeated giving way that is bad for the knee. Reducing the repeated giving way can be achieved by either avoiding pivoting activities, using an ACL specific sports brace or by reconstructing the ligament.



The decision to undergo reconstruction depends on weighing up all the relevant factors including the degree of instability of the knee and the sporting aims and aspirations of the individual.

For the individual who just wants to get back to light gym work, outdoor walking or skiing for example, surgery may not be required and the knee may feel stable enough after a period of rehabilitation or use of a special ACL brace. However, for a young keen sports person we know that there is a very high risk of sustaining further injury to the other structures in the knee after returning to sport with an ACL deficient knee, and therefore the stabilisation surgery is encouraged. (Fig Torn Meniscus)

Tear of the Meniscus – the protective shim in the knee, or footballer’s cartilage.

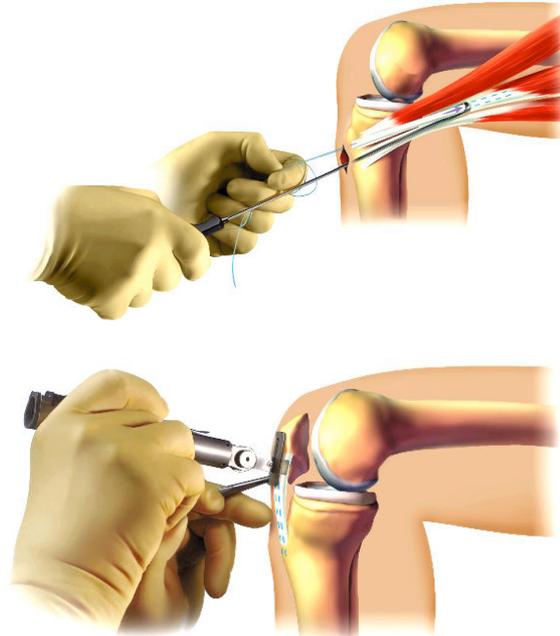


## 2. ANATOMIC ACL RECONSTRUCTION: The Operation

The 'keyhole surgery' operation to reconstruct the ACL involves replacing it with other strong tendons from areas around the knee. Two main grafts are in common use: the Hamstring Tendon graft and the Patella Tendon graft. Both are considered to be equally good and the choice usually depends on the surgeon's preference. Currently the Hamstring Tendon graft is favoured in most patients and it is probably best to avoid using the patella tendon if there is significant pre-existing pain in the front of the knee, or where employment involves kneeling or squatting. Postoperative rehabilitation is the same for each graft.

The hamstring graft is made from the semi-tendonosis and gracilis tendons, which are cord like structures behind the inner aspect of the knee. These two tendons are taken through a small incision on the front of the tibia and are folded in to make a four, five or six stranded structure (Fig).

The patella tendon graft is made from the central strip of the patella tendon that runs from the knee cap (patella) to the tibia; a small piece of bone is kept attached to the ligament at each end (Fig). Bone graft from the tibia is inserted at the end of the operation into the kneecap to restore contour and to help with kneeling.

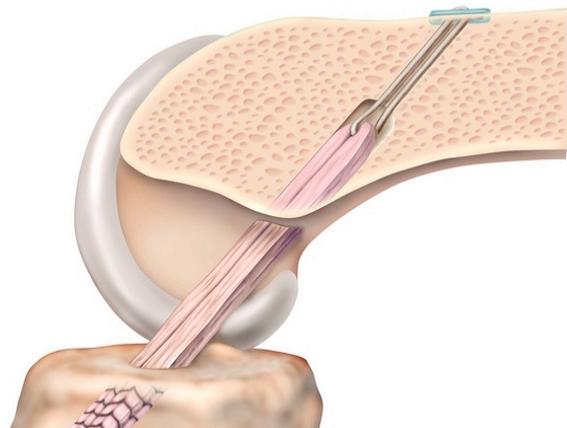


Surgery is performed under general anaesthesia and usually takes 1-1/2 hours. The chosen graft is harvested through small incisions and is prepared into a new ligament. The main part of the procedure is performed via keyhole surgery (arthroscopy). The bulk of the old ACL is removed to allow space for the new graft. The inside of the knee is prepared and tunnels are made in the tibia and femur at the anatomical site of the attachment points of the old ligament.

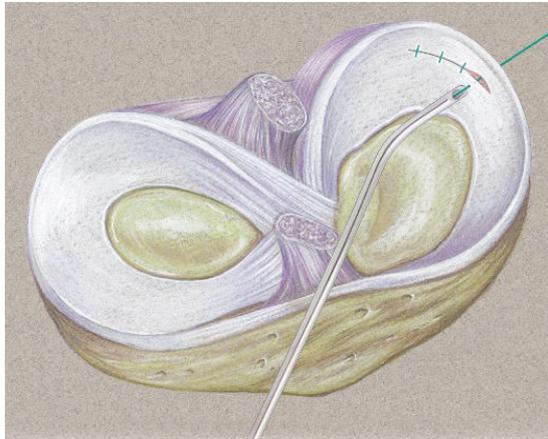
The new Hamstring Graft ligament is then held in place within the tunnels using a small metal bar (endobutton) on the femur and an absorbable screw at

the shin bone end. A Patella Tendon graft is held in place by two bio-absorbable screws which are slowly incorporated by the body. These fixation devices do not usually need to be removed.

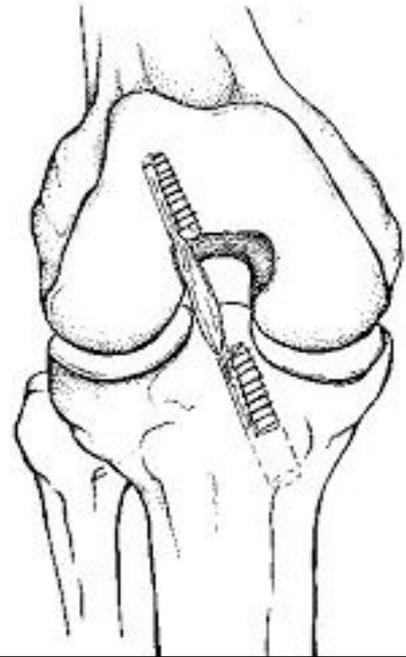
If the meniscus is torn, or the articular cartilage is damaged, then such damage can be tidied up or repaired during the same procedure. This may affect the rehabilitation time scales post



operatively.



Meniscal repair using sutures as an example



Patella tendon graft fixed in place with screws at each end

### **3. AIMS, RESULTS AND EXPECTATIONS OF THE SURGERY**

The aim of the operation is to prevent repeated episodes of giving way or buckling of the knee. Published research shows that approximately 90% of patients consider their knee to function normally, or nearly normally, after surgery. Full contact sport is allowed after rehabilitation but not everyone gets back to his or her previous level. Return to sport depends on the time period since injury and other personal or work factors.

It is important to emphasise that the new ligament is not a “normal” ligament. Re-creating stability with the graft is only one aspect of attempting to improve knee function after injury. Other problems such as joint surface damage or meniscal tears may co-exist which can interfere with the joint’s ability to tolerate high loads associated with sport and other arduous activities.

Also, the wear-and-tear arthritis associated with ligament injury is not necessarily prevented by reconstruction surgery and the risk of developing osteo-arthritis of the knee in later life is higher once the ligament has been torn.

#### **Potential Problems**

Problems can occur. Some are minor but some may need another operation to help. It is clearly important to understand these risks before undergoing surgery.

#### **The main risks include:**

- Failure to provide enough stability in the knee to allow return to full sporting activities. Either the ligament does not heal in a tight enough position to allow full confidence in the leg, or there is associated damage inside the knee that prevents return to full function.
- Patella pain or discomfort in the front of the knee joint during activities such as squatting or sitting with the knee bent can develop in 10 – 20% of patients, but this usually improves with specific rehabilitation. More importantly, it can be prevented by appropriate early rehabilitation and by closely following the guidelines and advice in this booklet.
- Complications of deep vein thrombosis, and wound infection can occur as in all operations. The risk is approximately 1 – 2%.
- Re-rupture of the graft, which occurs in approximately 2 – 4% of cases over 10 years. This is similar to the risk of rupturing the ligament in the other knee.

#### **Early “Normal” Concerns Following Surgery**

The following is a list of common events that can occur following surgery:

- Swelling: Swelling or “effusion” in the knee is usual until up to three months after surgery. The main aim of the first phase of rehabilitation is to reduce swelling.
- Difficulty kneeling: After any operation on the front part of the knee it takes a while to tolerate kneeling, but with gradual progression through use of a cushion then carpet and finally a hard floor, this usually improves.

- Bruising: It is usual for bruising to appear down the leg as far as the inner aspect of the heel. It can be surprisingly tender and may take four to six weeks to disappear.
- Numbness around the knee: Numbness around the scars on the front part of the knee is common as the nerves that supply sensation to the skin crisscross around the front of the knee. This can be quite disconcerting for a few months and some residual area of reduced sensation may persist in the long term. Usually this does not affect the function of the leg.

## 4. POST OPERATIVE REHABILITATION

### Introduction

The overall rehabilitation plan emphasises the importance of pre-operative exercises followed post operatively by early control of swelling and regaining full extension (straightening) and flexing of the knee (bending). Working on strength can only start once swelling and range of movement have been controlled. Return to function then follows.

### Key to Success

The key to successful rehabilitation is to regain normal, full straightening of the knee as soon as possible, and to control swelling in the early post operative phase before progressing to strength activities.

For the first six weeks, until the new graft is well bedded in and healed in place, exercises are performed gently with the aim of regaining normal bending and straightening as the swelling settles. Repetitive cycling of the knee is restricted during the first 6 weeks as this may overload the fixation of the ligament and lead to slippage of the graft and effective lengthening of the new ligament.



During exercises the foot is initially kept in contact with the ground or with the surface of an exercise machine – these are called ‘closed’ kinetic chain exercises.

Elevation of the leg between exercises to reduce swelling is also important and helps allow the bending to improve.

‘Open’ kinetic chain exercises, where the foot is unsupported, are introduced towards the end of the first six weeks as knee control and strength improves. This allows muscle strength to improve without putting excessive stress on the graft.

#### **Remember: This is only a guide**

It is important to emphasise that the rehabilitation guidelines in this booklet are only meant as a guide.

The plan is based on current evidence and available information on ACL reconstruction surgery.

The main milestones are the key; there are many different exercises to achieve those goals and different physiotherapists will have differing regimes to use within the overview of this guide.

Naturally, patients vary and exercises are tailored to each individual

## **General Principles for understanding the rehabilitation process**

Exercises need to be done 4 – 5 times per day: little and often is better than an extensive overload period.

Pain, heat and increasing swelling in the knee are potentially bad: Any of these symptoms can mean that exercises are being overdone. This is unlikely to indicate a serious problem, but these symptoms should be discussed with the physiotherapist.

The difference between good and bad pain: After major knee surgery the knee will be sore. It is important to understand that discomfort is normal - particularly when doing some of the stretching exercises. The knee may also ache after an exercise session. This is expected and normal so long as it is not associated with any significant increase in swelling. 'Bad pain' is usually sharp and severe in nature. It may be brought on by pushing too hard, and it may be accompanied by an increase in swelling. Activities causing such a problem should be stopped and advice sought from the physiotherapist.

## **Summary of Rehabilitation Phases**

There are six main rehabilitation phases and example exercises for each phase are given in the sections that follow. Many different exercises are available to achieve the goals and these are tailored to each individual by the physiotherapy team. Various example exercises are outlined in each section.

- Phase 1: Preoperative preparation/operative period.
- Phase 2: Initial Post Op Phase: First 2 weeks.
- Phase 3: Proprioception (sensory awareness) Phase: Weeks 3 – 6.
- Phase 4: Strength Phase: Weeks 6 – 12.
- Phase 5: Early Sport Training: Months 3 - 6.
- Phase 6: Return to Sport: Months 6 – 9.

**Specific Follow-up assessment:** Outpatient review takes place at the following times and the goals for those stages are detailed in the guidelines:

- 2 weeks
- 6 weeks
- 3 months
- 6 months
- 1 year

## **PHASE 1: PREOPERATIVE PREPARATION AND OPERATIVE PERIOD**

### **Pre Op**

Rehabilitation begins before surgery in the pre-operative phase to ensure that the individual and their knee are ready for the operation.

- Ensure full range of movement, especially normal hyperextension, i.e. so the knee extends to the same as the other leg.
- Exercises to maintain quadriceps and hamstring muscle strength. Start balance control exercises
- Advice session in the physio department for familiarisation with post op exercises and hospital stay.

### **Initial Post Operative Period**

The aim is to go home comfortable and ready for rehabilitation on the first postoperative day. Sometimes it is possible to go on the day of surgery.

The dressings are changed on the 1st postoperative day along with instruction on using crutches the exercises to be performed for the first 2 weeks.

Crutches are required for the first 2 weeks taking partial weight on the leg.

### **Instructions on Discharge from Ward**

The following is a list of instructions and expectations given before leaving the ward.

- Keep the wound dry for 3 days or until the wound has sealed.
- Instruction on use of Cryocuff or ice packs to control swelling.
- Clips or Stitches to be removed at 7 days by a local surgery or district nurse.
- Appointment for review in clinic or on the ward after 2 weeks.
- Date for first outpatient physiotherapy appointment.
- Work Advice: to expect to be able to return to work as follows:
  - Desk work at 3 – 4 weeks
  - Light manual work at 6 weeks
  - Heavy manual work (ladder work etc) at 3 – 4 months.
- Driving Advice: return to driving at 3 – 4 weeks depending on knee function.

## PHASE 2: INITIAL POST OP PHASE – FIRST 2 WEEKS

### Aim

The aim of this phase is to regain the range of joint movement and to allow swelling in the knee to settle. The most important aim is to regain normal and full extension (straightening) of the knee. After seeing the physiotherapist on the ward the next appointment is usually one week following surgery to add in extra exercises.

#### 2 Week Review Goals

Range of movement: full knee extension to 110° flexion  
Wound healed  
Minimal swelling in knee and around wound  
Normal walking pattern  
Independent leg control



## PHASE 3: PROPRIOCEPTION PHASE (Sensory Awareness) WEEKS 3 – 6

### Aim

The aim of this phase is to work on proprioceptive exercises and to develop light endurance and strength training. This stage is also important for developing core stability to help you progress to full active function. By the end of six weeks your knee should feel normal in activities of daily living.



#### 6 Week Review Goals

Full range of movement including normal hyperextension  
Minimal Swelling in knee  
Full patella mobility  
Minimal discomfort

#### PHASE 4: STRENGTH PHASE - WEEKS 6 – 12

##### Aim

At six weeks the graft will be solidly fixed into bone so that more vigorous strength training can start. Thigh muscle tone and definition (quadriceps / hamstrings) will be hopefully have been maintained during the first post op phase and now the main strength work can begin. Progress is monitored and controlled by the recovery of strength and muscle control.

It is important to avoid too rapid progress, as there is a risk of developing overload complications.



##### 3 Month Review Goals

Full range of movement  
No swelling  
Confident feeling of stability

#### PHASE 5: EARLY SPORT TRAINING PHASE - MONTH 3 - 6

##### Aim

Pivoting and cutting movements are introduced at this stage, building up to light sport training. This involves a progressive programme of slow and moderate speed strength training and agility drills. Manual work should be possible within the restraints of the occupation. Exercises for power and agility training are introduced.

Many sport specific skill training exercises can be introduced at this stage and detail for particular sports is given in the next section as there is some overlap during these phases. The new ligament is still at significant risk of re-injury or of stretching out if progress back to full levels of sport is too fast.

There is no one solution that fits all individuals great emphasis is given on the care in progressing through this phase back to sport. Supervision by a Physio, sports coach or trainer is key, as drill and skill acquisition is dependent on individual muscular control patterning in addition to individual relative strength deficits around the hip, knee and ankle.



##### 6 Month Review Goals

Full Range of movement  
Functional and Strength tests: 85% of normal side  
Return to non contact sports training

## PHASE 6: RETURN TO SPORT PHASE – MONTH 6 – 9 and beyond

### Aim

The aim of this phase is to progress sport training and to develop strength and endurance levels to allow return to full sporting activity. This takes time, especially in building up confidence to progress to full contact activities.

Return to contact sport is not recommended until strength and functional outcomes are measured at greater than 85% of the normal knee.

It should be remembered that the time to regain pre-injury level of skill and performance is very variable but can take 3 – 4 months of training and playing. This confidence can be helped by introducing modified training and specific drills early, often in conjunction with club or team activities.



Progress is best achieved in conjunction with a general fitness programme, as this will have reduced over time since the injury and surgery.

Full contact sport is, in general, best avoided until able to tolerate a full -training session with confidence in full fitness and endurance.

The full rehabilitation document outlines the principles of getting back to the same level of sport and draws on the knowledge gained by understanding the possible mechanisms for injuring the ligament in the first place.

## Returning to sport after ACL reconstruction and prevention of re-injury

### Introduction

This section describes the techniques to try and optimise return to sport following ACL reconstruction. The first section summarises the overall principles of getting back to sport, and this is then followed by more in-depth concepts for specific sports. Various different rehabilitation experts have contributed to this section.

Getting an individual back to their previous level takes specific rehabilitation tailored to the particular sport. Whilst the goal is clearly to get back to playing the same sport at the same level as before the injury there are various factors that need to be integrated including **expectations, confidence, relearning old skills** and **learning new skills**. These need to be identified and discussed.

We outline the main phases of returning to sport, coping with the mind of the athlete and discuss what has been learnt from analysis of why the female is more at risk of rupture of the ACL.

### Four key factors

The factors are as follows and these need to be individualised.

#### a) Expectations

There may have been a long downtime between injury and finally undergoing surgery such that other events such as age, business or family commitments may alter the ability to get back to sport at the same intensity.

#### b) Confidence

It can take a long time for an individual to regain the confidence in putting their knee and their body in to such a situation where it may be reinjured again. For the footballer, for example, though they may get back playing at nine months, it may not be until a year after surgery before they have fully forgotten their knee. It seems to be a natural human tendency that after a while injuries are forgotten and the confidence seems to return.

#### c) Relearning Old Skills

Each sport can be broken down in to the specific drills and processes that are needed to perform well and these need to be identified along with the time intervals and goals before proceeding to the next specific skill. The phases follow a progression through regaining strength and then regaining functional knee control.

#### d) Learning New Techniques

Sometimes the reason why the ACL ruptured in the first place was because of a poor technique such as poor landing control after jumping, leading to buckling of the knee. This is especially true for the female athletes who have a higher risk of rupturing their ACL as described in the next section. Individuals may need to *unlearn* some aspects of their sport and *relearn* new techniques in order to prevent reinjury.



Sarah Webb – in the front - winning Olympic Gold Medal after ACL Reconstruction

### Return to Sport Phases

For every sport the return to activity can be discussed under the following headings:

- Understanding the specific skill of the sport
- Ranking the specific skills by difficulty and risk to the knee
- Drills and techniques to achieve each target
- Understanding other activities that are safe to perform during rehab



**Detail for various sports are given in the full rehabilitation booklet obtainable from Mr Spalding.**