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The Guide to Accelerated Rehabilitation of Anterior Cruciate Ligament (ACL) Reconstructed Knees

INTRODUCTION

Anterior cruciate ligament surgery and rehabilitation have undergone dramatic changes over the past decade, due to extensive clinical experience, improved surgical technique and better understanding of rehabilitation. Pre and post-operative rehabilitation is a major factor in the success of ACL reconstruction. Early restoration of full joint movement and weight-bearing are of paramount importance for successful rehabilitation. We aim to ensure a complete understanding of the basic principles of the ACL reconstruction, to restore the full range of motion, near normal strength and to mentally prepare the patient for the operation and accelerated rehabilitation. The major goals of ACL surgery and rehabilitation are: to restore normal joint anatomy, to provide static and dynamic knee stability and return to work and sport as soon as possible. It is very important that the patient takes an active part in the rehabilitation, both before and after the operation. Our goal is to guide our patients through the rehabilitation without unnecessary restrictions. Therefore, this is not a protocol or a strict regime, but an overall rehabilitation guide.

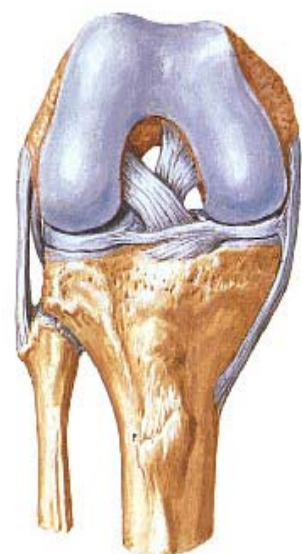
This program is based on accelerated rehabilitation principles and extensive experience of *Donald Shelbourne, MD* and *Mark De Carlo, MHA PT SCS ATC*, of the Methodist Sports Medicine Center, Indianapolis, Indiana, USA.

ABOUT THE ACL

The knee is a complex joint, which has the ability to bend and rotate slightly. Knee ligaments help control motion by connecting bones and bracing the joint against abnormal types of motion. The ACL links the back of the **femur** (thighbone) to the centre of **tibia** (shinbone), stabilising the knee, mainly in the forwards and backwards direction.

In addition to its mechanical restraining function, the ACL provides important neurological feedback that directly affects perception of joint position, and reflex muscular stabilisation of the joint or **proprioception**. Conscious and subconscious proprioception is essential for normal joint function in daily activities, occupational tasks and sports. Proprioception diminishes following capsulo-ligamentous injury, but is significantly restored following surgical ACL reconstruction and rehabilitation.

A typical mechanism of an ACL injury is a non-contact twisting movement, usually due to abrupt deceleration and change of direction. Side-stepping (cutting), pivoting and landing from a jump are examples of events that may cause an ACL tear.



Drawing: F. Netter

An audible pop or crack, pain and the knee giving way are typical initial signs, followed by almost immediate swelling, due to bleeding inside the joint. Associated damage to other important joint structures, such as collateral ligaments, menisci, and articular cartilage is very frequent. Some patients achieve satisfactory stability and function with non-operative treatment (rehabilitation and adjustments to daily activities and sports). However, chronic ACL deficiency results in gradual damage to the menisci and articular cartilage and consequent early joint degeneration.

ACL RECONSTRUCTION

ACL reconstruction is not an emergency operation.

Delaying surgery until a full range of motion is obtained significantly reduces the chance of having problems post-operatively. Delaying acute surgery also allows the patient to be mentally better prepared for surgery and gives the patient time to learn, fully understand and practise adequate exercises.

A complete tear of the ACL has minimal ability to heal and often requires surgical reconstruction. This involves replacing the torn ligament, usually with the middle third of the patella tendon (**bone-patella tendon-bone autograft**). Fastening the graft to the bone with interference screws provides secure fixation which enables early accelerated progressive rehabilitation to take place.

Surgery is followed by 1 to 2 days of hospital stay and by several months of intensive rehabilitation to restore normal range of motion, strength, flexibility and proprioception.



PRE-OPERATIVE REHABILITATION

Pre-operative rehabilitation is extremely important for the successful outcome of ACL reconstruction. Patients with an ACL deficiency, suitable for reconstructive surgery, are educated on the nature of their problem, surgical technique and peri-operative rehabilitation, by the surgeon, at the time of the first clinic visit. They are also visited by the physiotherapist, prior to the operation, and guided through an updated rehabilitation programme. Regaining a full range of motion, strength and proprioception before and the operation, especially full symmetrical hyperextension, minimises post-operative problems.

IMPORTANT: BEFORE THE OPERATION!

- ✓ You should be familiar with the full range of postoperative exercises.
- ✓ You should have a full range of knee movement and good leg muscles.
- ✓ Do not forget to tell us if you have any allergies or any medical or anaesthetic problems.
- ✓ Please remember that any skin problems with your knee (wounds and cuts in any stage of healing) are not compatible with ACL surgery.
- ✓ If you are taking the contraceptive pill please remember to stop taking the pill 4-6 weeks prior to your operation. Please ask your GP about further details.
- ✓ Do not take Aspirin for two weeks before surgery.
- ✓ On admission to the hospital: bring your regular medication, relevant medical records and x-ray films.
- ✓ Your operation may be recorded on the video tape or digitally, and kept as a part of your hospital record, or used for training and educational purposes. If you wish to have your own copy please bring mini-DV videotape and remind us to record your arthroscopic operation.
- ✓ You are allowed to eat solid food up to 6 hours and drink clear fluids up to 3 hours before the operation.
- ✓ Please complete the attached **KOOS** form and return it to your Surgeon.

AFTER THE OPERATION

Day 1 and 2

- ❑ **Knee is not braced or immobilised**, unless specifically agreed preoperatively
- ❑ **Antibiotics:** iv *Cefuroxime*, up to 24 hours post-operatively.
- ❑ **Pre-emptive and postoperative pain management** (*Ketorolac and Tylex*).
- ❑ **DVT prophylaxis:** early foot and leg exercises and mobilisation.

- ❑ **Swelling control:**
Aircast Cryo/Cuff (cold pressure dressing) applied in operating theatre. Use most of the time, when in bed **and** mobilising.



- ❑ **Full passive extension** immediately post-operatively and throughout the hospital stay (*use folded pillow under heel when in bed*). Use heel props and **do straight leg raise**.
- ❑ When you return to your room from recovery unit start moving your operated knee gently (*bending and straightening*). If this hurts, slow down and rest.
- ❑ **Weight-bear as able**, aided with elbow crutches. Aim to progress to full weight bearing, by the following day (once you have satisfactory quadriceps control, gait and knee extension).
- ❑ **Start with basic proprioceptive exercises as soon as you start weight-bearing:** briefly shift weight on the operated leg and try to balance on one leg (*this may be painful and difficult!*).
- ❑ As you gain confidence try this holding on to a solid object (*washbasin*) and progress supervised to the same with eyes closed. You should be able to do this by second day post-operatively. Progress to moving football around leg, while weight-bearing, with crutches.
- ❑ Reduce **dressing** to skin cover only, 24 hours post-operatively
- ❑ **Progress to adapting activities of daily life to one legged proprioceptive exercises** (balance on operated leg when brushing teeth, combing hair, using the phone).
- ❑ **Prone knee hangs:** aim for symmetrical hyperextension.
- ❑ **Active knee bending** in side lying, or on sliding board.
- ❑ **Resisted knee bending** in sitting, over edge of bed.
- ❑ **Static hamstrings** at points in range.
- ❑ **Static quads** in full extension (*active extension from 40 to 0 degrees is contraindicated*).
- ❑ **Patella mobilisation:** teach self-treatment exercises and how to relax quads when doing this.

- ❑ **Discontinue any exercise that causes unexpected pain and discuss it with your physiotherapist or surgeon.**
- ❑ **Discharge from the hospital, if progressing well, on day 2 post-operatively.**

PROPRIOCEPTIVE EXERCISES:

Balance and proprioceptive training are very important components of this rehabilitation program. A quick and easy way of doing daily proprioception and balance exercises is to stand on one leg while brushing your teeth. This gives you regular opportunities to exercise proprioception for several minutes, a couple of times each day. Even if you have poor balance and proprioception initially, you

can do your exercises whilst holding on to the sink with the opposite hand. As your skill level improves you can progress to “no hands” exercises. The next skill level involves the same exercise but with closed eyes, which may feel strange and will require some practice. Once these exercises become too easy, try to lean in different directions (while standing on one leg and brushing teeth), and then stabilise yourself without losing balance. This will enable you not only to master the skill of standing in one spot, but also to fine-tune the ability to balance once the centre of gravity has moved. Also, remember, that brushing teeth up and down and sideways are very different proprioceptive exercises.

3 to 14 days

- ❑ **Proprioceptive aptitude:** improve on balance with eyes shut, shift weight from one leg to other, walk along lines in all directions, catching ball, move ball around foot, use wobble board. Increase one-legged activities.
- ❑ Continue to **progress with full extension** exercises, and progress to **closed kinetic chain exercises** (*always exercising with full weight through the leg*).
- ❑ **Flexion exercises:** wall and heel slides. Aim for 90 degrees by the end of second week post-operatively.
- ❑ **Normalise gait:** walk in front of mirror.
- ❑ **Discard crutches** once walking well and confident in activities of daily living.
- ❑ Contact your physiotherapist if you have problems with your knee or exercises.
- ❑ **At 1 week postoperatively: first follow-up (Surgeon and Physiotherapist)**

2 to 6 weeks

- ❑ **At 3 weeks: second follow-up (Physiotherapist only), advice on driving and return to work.**
- ❑ **Continue to progress according to your abilities.**
- ❑ **Progress with closed kinetic chain exercises.**
- ❑ **Progress** unilateral exercises: sitting to standing, dips, exercise bike and step machines.
- ❑ **Progress with resisted hamstrings** exercises.
- ❑ **Progress with** dynamic proprioceptive exercises.
- ❑ Carefully resume **pre-operative gym level**.
- ❑ **Swimming:** straight leg kick only, and pool exercises.
- ❑ **If you have patella problems** (clicking, grinding, pain) try taping patella medially.
- ❑ **You should have a full range of movement** (*symmetrical full hyperextension to full flexion*) **by the end of this period.**

DRIVING

Very little information exists in current literature about the ability of ACL injured or reconstructed knees to respond to situation-specific stimuli, such as braking quickly while driving a car. It is difficult to determine when it is safe to return to driving following surgery. A recent study from Australia seems to indicate that following a right ACL reconstruction patients should wait at least six weeks before driving again. However, this could take place at two weeks for patients with left ACL reconstruction (or when they are able to operate the clutch if they are driving a manual car).

FLYING

There is no universal agreement as to when it is safe to travel by plane after an ACL reconstruction. It seems that most Orthopaedic Surgeons advise their patients not to fly for 4 to 6 weeks following the ACL reconstruction.

Short flights do not seem to be a problem. However, long intercontinental flights are a potential problem as there is an increased incidence of spontaneous DVT (deep venous thrombosis), even in the young and healthy passengers. It is possible that sitting for long period of time, in a confined space and with very little leg room in economy class, could predispose to the development of deep venous blood clots, even in healthy individuals, and especially in people following recent knee surgery. If you have to travel by plane, between 2 and 4 weeks after your ACL reconstruction, it would be wise to contact your airline's Medical Department and ask them for advice. Also, please discuss this issue with your GP, as you may have to take prophylactic medication such as Aspirin or other anticoagulants for several weeks.

6 to 12 weeks

- At 6 weeks: third follow-up (Surgeon and Physiotherapist).**
- Continue progress:** increase gym workouts, step ups and step downs, shuttle runs, ball dribbling etc.
- Continue to improve your confidence, gait and proprioceptive aptitude**
- Prone "leg flicks"** to stimulate hamstring reflex contraction.
- Swimming:** continue regularly (*no breaststroke*).
- Cycling** on normal cycle.
- Start jogging**, on the flat, preferably slightly uphill (*but not downhill*) or on the angled treadmill.

3 to 6 months

- At 3 months: fourth follow-up.**
- Isokinetic testing (the involved quadriceps strength should be 70% of the non-involved, at three months).
- Introduce sport specific exercises.**
- Progression of strength work: leg press, leg curls etc.
- Agility work:** catching a ball, sideways running, 2 leg jumping, skipping rope etc.
- Single leg hop test** (*start with the good leg, try with operated one and if you can manage 20 to 30 hops around points of 60 cm square, you can gradually return to your previous non-contact sports*).

6 to 9 months

- At 6 months: fifth follow-up.**
- Isokinetic testing (the involved quadriceps strength should be 80% of the non-involved, at six months).
- Return to sport specific training** and participating in skill exercises as well as improving power and endurance.
- Plyometric exercises**
- Return to contact sports** (provided: no swelling, no ligament laxity, full mobility, full muscle strength and proprioception, equal or better than the opposite leg).

9 to 12 months

- Follow-up at 12 months:** completion of the **IKDC** Knee Form.
- Isokinetic testing** (the involved quadriceps strength should be 90% of the non-involved, at one year).
- Despite return to sports activities, at 6 to 9 months, it still takes an additional 3-4 months of training and playing a specific sport without restrictions until patients feel that they are back to close to the pre-injury level.

POSTOPERATIVE PROBLEMS

BRUISING and SWELLING are frequent but transient postoperative problems - both disappear gradually after 6 to 8 weeks.

EARLY POSTOPERATIVE PROBLEMS: if you have problems with your knee, especially before your first follow-up appointment (skin redness, skin blistering, persistent wound discharge, excessive knee swelling and pain) please contact your surgeon: **mobile telephone 07774 981 481**.

OTHER PROBLEMS: Call your **GP** if you develop calf pain and tightness, shortness of breath, or if you develop a fever and feel unwell. If you have any problems, especially if you experience skin redness, excessive swelling, wound discharge, or severe pain during or after exercise, please call our Physiotherapists or your Surgeon.

PATELLA PAIN: There is a definite, but frequently overstated, morbidity that occurs from harvesting a middle third of patella tendon. Occasionally, patients may complain of **anterior knee pain** (patello-femoral pain, patella tendon pain, bone graft site: lower pole of patella or tibial tuberosity) during exercises, on kneeling, squatting etc., for up to 2 years after ACL reconstruction. This is a relatively infrequent problem in our practice.

PERMANENT QUADRICEPS WEAKNESS: a relationship has not been established between permanent quadriceps weakness and patellar tendon graft ACL reconstruction. Based on isokinetic strength testing, involved quadriceps strength of 70% or more of the non-involved extremity should be achieved by three months postoperatively, which is sufficient to allow participation in initial agility activities.

JOINT-LINE PAIN: meniscal and articular cartilage damage are very frequently associated with ACL injury. Chronic ACL laxity almost inevitably results in progressive damage and degeneration of menisci and articulating surfaces. Postoperative pain (which is usually on the inner aspect of the knee at the level of the joint) especially during exercises that involve repetitive impact, is usually a sign of chondral or meniscal damage. This type of postoperative pain is relatively frequent problem in our practice, but mainly in chronic ACL deficient knees.

PROPRIOCEPTION: due to diminished proprioception, and despite satisfactory stability, the operated knee does not feel right for a long time. Regular proprioceptive exercises and a simple **compressive knee sleeve** (elastic bandage, double tubigrip) worn intermittently, is known to help with this problem by applying skin pressure, which indirectly stimulates intra-articular mechanoreceptors and enhances overall knee joint proprioception.

COMPLICATIONS are uncommon, but may occur occasionally: lack of full extension, hyperextension, and flexion, anterior knee pain, donor site tenderness, graft laxity and rupture, deep venous thrombosis, skin and joint infection.

REHABILITATION PROBLEMS: many of the complications seen following this particular reconstructive procedures are secondary to inadequate postoperative rehabilitation: flexion contracture, residual quadriceps weakness, and extensor mechanism dysfunction including patello-femoral pain, patellar tendonitis, patella tendon contracture, etc. However, most complications are preventable through implementing structured accelerated rehabilitation: achieving full hyperextension helps to minimise anterior knee pain, the cause of patella tendonitis is often in increasing activity level too quickly and trying to work through the pain.

QUESTIONS: if you have questions about your rehabilitation please contact our **Physiotherapy Department on 01244 684 314**.

FUNCTIONAL FAILURE: The average (international) failure rate, in terms of return to pre-injury level of activities, with this particular graft and technique, is up to 20% in competitive and contact sports, and up to 5% in activities of daily living and fitness training. ACL reconstruction does not restore knee function to normal, especially if there are other intra-articular problems like meniscal and chondral deficiency.

SUCCESS FOLLOWING RECONSTRUCTIVE ACL SURGERY depends upon many factors of which rehabilitation is of utmost importance. The most perfectly performed surgery can be quickly undone by overzealous rehabilitation and insufficient rehabilitation can lead to joint stiffness, muscle atrophy and a poor functional result.

FOLLOW-UP APPOINTMENTS: if you wish to change your appointment please call **Consultation Bookings on 01244 684 318**.

This rehabilitation guide is based on our experience in ACL reconstructions and rehabilitation since 1992, in Exeter, Liverpool and Chester, on over 800 patients. It has been developed according to contemporary high standards of leading national and international ACL surgical and rehabilitation centres. The main aim of ACL rehabilitation programme is to follow carefully all patients preoperatively and postoperatively and advance the program to minimise postoperative complications, maintain ACL stability and allow a faster return to daily activities while progressing to full work ability and sporting activities. Future modifications of this rehabilitation guide are inevitable and will be based on those changes which give the patient the best short and long term results.

NOTES: