

PHYSIOTHERAPY PROTOCOL ENDOSCOPIC ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

INTRODUCTION

Anterior cruciate ligament reconstruction has become one of the most commonly performed surgical procedures to the injured knee joint. The rationale for surgical treatment is to stabilise an unstable joint, or potentially unstable joint, with the aim of preventing giving way of the joint under load. Joint stabilisation has been shown to decrease meniscal and articular cartilage damage, which potentially decreases the incidence and severity of later osteoarthritis change.

Surgical techniques have advanced greatly over the past decade along with post-operative management protocols. This, in part, has been driven by patient non-compliance with traditional protocols. Accelerated rehabilitation protocols have been developed and in this paper are defined as – immediate full weight bearing, immediate full extension and immediate active and passive mobilisation of the knee joint.

As surgical techniques have become more accurate and less invasive with the advent of arthroscopic techniques, post-operative morbidity has decreased. This has had two effects. Firstly, it has reduced the period of hospitalisation and subsequent rehabilitation. Secondly, it has increased the number of patients to which surgical management is realistically possible. Numerous studies have shown that, regardless of surgical technique, reduction in post-operative morbidity is possible with an accelerated rehabilitation protocol.

OUTLINE OF THE SURGICAL PROCEDURE

Arthroscopic surgery removes the ruptured anterior cruciate ligament stumps and any concomitant meniscal surgery is carried out. Articular cartilage damage and other pathology is then noted by the surgeon, as these may affect the post-operative management protocol.

An autologous graft is harvested using the mid-third patellar tendon or semitendinosus and gracilis tendon. This graft is then prepared and placed with the joint in an isometric and anatomic position. A graft so placed will allow a full range of joint motion without undue force on its fibres. Current fixation techniques include interference fit screw fixation, endobutton and suture and post fixation techniques.

These have been shown, in experimental studies, to have enough immediate rigidity of fixation to allow an accelerated mobilisation programme. As many of these patients now have their surgical procedure carried out on an out-patient basis in a day surgery, the physiotherapy regime is frequently commenced the following day in the physiotherapy clinic.

Arthrofibrosis is more frequently seen in those patients who undergo acute anterior cruciate ligament reconstruction or who have concomitant capsular and collateral ligament damage. These patients have a “springy” restriction to the extension and flexion with capture of their patella. This type of restriction improves with aggressive active and passive mobilisation. On the other hand, non-isometric graft placement frequently results in the rapid return of a limited range of motion, more commonly with limitation of terminal extension and/or flexion. These patients have a solid block preventing further movement. The joint is usually stable to the Lachman’s test and pivot shift. The joint has been constrained by the graft and further mobilisation will result in either graft damage (graft rupture will result in a full range of motion, but instability or joint damage due to compression of the articular surfaces).



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AIMS OF PHYSIOTHERAPY

Physiotherapy should ideally commence pre-operatively. Patients who have a pain free, mobile and healthy joint recover far quicker and with less complications than those with surgery carried out on painful joints. Even patients with chronic injuries benefit from pre-operative assessment and pre-operative "programming". It has been our experience that, if patients have learnt the exercises required pre-operatively, they have fewer problems with these exercises post-operatively. As stated earlier, many patients now have their procedure carried out as out-patients in a day surgery and their physiotherapy is commenced in the acute post-operative stage the same day. Over the next three to six months, the following are treatment goals:

- Diminish post-operative pain and swelling. Pain and swelling occurs from two areas. First, the joint with post-operative effusion and quadriceps inhibition and secondly, from the donor site, be it patella tendon or hamstring tendon.
- Restore a full range of motion.
- Restore muscle tone and strength.
- Maintain and develop aerobic conditioning.
- Proprioceptive retraining, allowing a safe return to work and sport as soon as possible.

It is essential that the patient is aware that he/she has an active part in their own rehabilitation and is aware of the workload involved.

The rehabilitation programme is not a recipe and should be modified for the patient's goals and individual characteristics, which include:

- Age
- Associated pathology – eg. Meniscal suture, meniscectomy, osteoarthritis, chondral damage, osteoplasty.
- Acute or chronic injury with or without associated collateral ligament damage, necessitating brace immobilisation.

RATIONALE OF PROGRAMME DESIGNS

This programme has been based on the following known information regarding anterior cruciate ligament reconstructive surgery.

- Early mobilisation has advantages such as maintenance of articular cartilage nutrition, retention of bone mineralisation and helping to prevent arthrofibrosis. Braces, if used, should be aimed at obtaining full extension.
- Progressive controlled loading of the graft provides a stimulus for collagen healing and regeneration. This is a needed stimulus for growth. It is very difficult to overload a graft placed in the correct isometric and anatomic position.
- Weight bearing has not been shown to be detrimental to the graft and progression to full weight bearing is allowed as rapidly as pain permits.
- It is assumed that the technical aspects of the surgical procedure allow for immediate graft fixation sufficient to allow aggressive mobilisation. This fixation to bone improves with the passage of time as the attachment "ligamentises". It is also based on the assumption that the graft is probably never stronger than the day it is implanted.
- Kinematic research has shown that open chain extension exercises cause significantly more anterior tibial displacement (and force on the graft) than closed chain activities.
- With injury to the joint resulting in the loss of the anterior cruciate ligament's function, there is also a significant loss to the joint's mechanoreceptors. Therefore, a large emphasis must be placed on proprioceptive retraining prior to the return to unrestricted sporting activities.

THE STAGED PROGRAMME

STAGE 1

Time period: Day 1 – 14 (sutures removed)

AIM

- Post-operative pain relief and management of soft tissue surgical trauma.
- Progress towards normal gait pattern. To remain on crutches until walking without a limp – may take up to a month.

GOALS

- Wound healing
- Manage the graft donor site morbidity, ie: pain and swelling
- Decrease joint swelling
- Restore full extension
- Establish muscle control

POSSIBLE PROBLEMS

- Infection – the patient complains of a constant, severe pain (throbbing with every heart beat). The patient is sweaty, ill and has a tense effusion. If no prophylactic antibiotics were given at surgery, infection usually occurs within the first 72 hours. However, if prophylactic antibiotics were given at surgery (as is usually the case) infection may come on insidiously 5 – 10 days post-operatively.
- Post-operative haemorrhage into the graft donor site. This results in a red, hot, tender area. Joint motion is not usually restricted except when pressure is placed on the graft donor site. Characteristically, the patient complains of pain when blood rushes to the donor site upon standing or hanging the limb dependent.
- Hamstring strain or pain.
- Deep venous thrombosis. The patient has calf, popliteal, thigh or groin pain and tenderness with associated swelling of the limb.
- Stiffness due to early arthrofibrosis or reflex sympathetic dystrophy.

TREATMENT GUIDELINES

- Reduction of swelling and pain using ice, elevation, co-contractions and pressure pump.
- Partial weight bearing to full weight bearing as pain and swelling allow.
- Active range of motion, aiming for full extension (but not hyperextension) by 14 days. Flexion will come without a great effort.
- Patella mobilisations to maintain patella mobility, particularly if patella bone-to-bone graft.
- Gait retraining with full extension at heel strike.
- Remain on crutches until walking without a limp. This usually takes about 4 weeks.

Due to post-operative pain and swelling, early return of co-ordinated muscle function may be encouraged with the use of biofeedback and selective muscle stimulation if necessary. Caution should be taken following patellar tendon grafts in stimulating the quadriceps mechanism as patella fracture has been reported.

Early active quadriceps strengthening is begun as a static co-contraction with hamstrings emphasising vastus medialis obliquus control at various angles of knee flexion and progressing into weight bearing positions.

Gentle hamstring stretching is initiated immediately to minimise painful adhesions. Hamstring tears, with the patient reporting a “pop” about the posteromedial thigh, are common within the first 14 days and even within the first six weeks.

Early active hamstring strengthening should begin with static weight bearing co-contractions, and progress through to active free hamstring contractions by day 14. Resisted hamstring strengthening should be avoided for at least 4 – 6 weeks. At 10 – 14 days post-operatively, the dressings will be removed and the wound checked.

NB: Quadriceps exercises are to be closed chain only during the first four stages.

NOTE - MENISCAL REPAIR

- Partial weight bearing for 6 weeks.
- Splint 0 – 90° for 6 weeks.
- Progress as per usual following 6 weeks.

STAGE 2 – HAMSTRING AND QUADRICEPS CONTROL

Time period: 2 – 6 weeks.

AIM

- To return the patient to normal function.
- To prepare the patient for Stage III.

GOALS

- Obtain a full range of unrestricted range of motion.
- Develop good muscle control and early proprioceptive skills.
- If not done sooner, restore a normal gait.
- Reduce any persistent effusion.

POSSIBLE COMPLICATIONS

- Stiffness
- Recurrent hamstring strain.
- Increasing laxity of the graft
- Graft failure.

TREATMENT GUIDELINES

- Aim for a full range of motion using active and passive techniques (avoid hyperextension).
- Progress co-contractions for muscle control by increasing the repetitions, length of contraction and more dynamic positions, eg two leg quarter squats, stepping, elastic cords.
- Commence swimming once the wound has healed, around week 4. (Walking, high knee lifts, etc. No breaststroke or kicking).
- Gym equipment can be introduced gradually such as stationary bike, (no resistance) at the start of the 6th week.
- If swelling is persistent, continue with the use of a pressure pump, ice and static quadriceps exercises. Hold back on gym activities until the effusion is settling.
- Hamstring strengthening automatically progresses with the increased complexity and repetitions of co-contractions. Open chain hamstring exercises are also included at this stage, although often they are painful. It is important to concentrate on hamstring stretches and to incorporate resistance gradually to prevent recurrent injury.

WEEKS 3 – 4

Low resistant (eg 1 – 2kg ankle weight) bilateral hamstring curls are progressed to low resistant unilateral curls as pain allows.

WEEKS 4 – 6

Care must be taken as hamstring straining may occur and impede further progression. Low resistance, high repetition weights aim to increase hamstring muscle endurance. Continue with intensive stretching exercises.

WEEK 6

Eccentric hamstring strengthening is progressed as pain allows. Hamstring curl equipment can be introduced. Consider beyond the knee joint for any deficits, eg. Gluteal control, tight hamstrings, ITB, gastrocnemius and soleus, etc.

NB: With the accelerated programme, patients can feel very confident by 6 weeks. However, it must be stressed that the graft is still not mature and they must be aware of their functional restrictions to avoid the risk of graft failure.

STAGE 3 – PROPRIOCEPTION

Time period: 6 – 12 weeks

AIM

- To improve neuromuscular control and proprioception.

GOALS

- Continue improve total leg strength.
- Improve endurance capacity of muscles.
- Improve patient confidence.

POSSIBLE PROBLEMS

- Arthrofibrosis.
- Patellofemoral irritability.
- Chronic inflammation.
- Graft laxity and rupture.

TREATMENT GUIDELINES

- Progress co-contractions to more dynamic movements, eg, step lunges, half squats.
- Proprioceptive work should be more dynamic from week 9, eg. lateral stepping, slide board etc.
- Progress resistance on gym equipment such as leg press and hamstring curls. Hamstring strengthening programme aims for a progression in both power and speed of contraction.
- Start cycling on normal bicycle from week 9.
- Consider pelvic and ankle control plus cardiovascular fitness.

NB: Still no open chain quadriceps exercises. Solo sports such as cycling and swimming are usually permitted with little or no restriction during that stage.

STAGE 4 – SPORT SPECIFIC

Time period: 12 weeks to 6 months

AIM

- Prepare to return to sport.

GOALS

- Incorporate more sport specific activities.
- Introduce agility and reaction time into proprioceptive work.
- Increase total leg strength.
- Develop patient confidence.

POSSIBLE PROBLEMS

- Patellofemoral irritability.

TREATMENT GUIDELINES

- Progressing of general strength work, eg. Half squats with resistance, leg press, leg curls, wall squats, step work on progressively higher steps, stepper and rowing machine.
- Begin jogging on a flat surface, in a straight line, from week 16.
- Proprioceptive work should include hopping and jumping activities emphasising a good landing technique. Can incorporate lateral movements.
- By about twenty weeks, agility work may include , ball skill, sideways running, skipping rope, etc.
- Low impact and step aerobic classes help with proprioception and confidence.
- Pool work can include using flippers.
- After twenty weeks, begin sport specific activities which will vary for the individual. Eg. Tennis – lateral step lunges, forward and backwards running drills. Skiing – slide board, lateral box stepping and jumping, zigzag hopping. Volleyball or basketball- vertical jumps.

NB: The above activities are gradually introduced throughout Stage 4.

STAGE 5 – RETURN TO SPORT

Time period: after 6 months.

GOALS

- Return to sport safely and with confidence.

TREATMENT GUIDELINES

- Can safely do open chain quadriceps work (ie. leg extensions).
- Continue progression of plyometrics and sport specific drills.
- Return to training and participating in skill exercises.
- Continue to improve power and endurance.

Advice may be needed as to the modifications required when returning to sport, eg. Football – start back training in running shoes or short springs, usually returning to lower grades initially. Skiing – stay on groomed slopes and avoid moguls and off piste initially. Racers may initially lower their DIN settings on the bindings.

APPENDIX

Co-contraction Exercises

In relation to the knee, these exercises ensure that both the hamstring muscle group and the quadriceps muscle group contract simultaneously to achieve a bracing effect on the knee joint.

Not only will these two groups be contracting however, but stabilisers above and below will also contract such as gluteals, psoas, TFL, adductors and calf muscles.

To initially teach a co-contraction, it is easiest to place a rolled pillow under the knee and ask the patient to push the pillow. This will switch on the hamstrings and gluteals. They should then tighten the quadriceps.

A co-contraction should initially be held for approximately 15 seconds.

Open v. Closed Chain Exercises

Closed kinetic chain exercises are performed with the foot placed on a surface (eg. floor, step, pedal) and the entire limb is bearing an axial load.

Joint compression occurs when the limb is loaded by body weight and this provides inherent joint stability and allows more strenuous strengthening without the degree of shearing forces or anterior tibial displacement that occurs with conventional open kinetic chain exercises. Closed chain exercises performed with co-contraction of hamstrings and quadriceps also lessen the patellofemoral joint surfaces.

The closed exercises place functional stresses on the joint and entire limb. These exercises can easily be designed to be specific to normal weight bearing activities used for ACL as well as sport.

Plyometrics

Plyometrics exercises are characterised by very powerful muscle contractions in response to a dynamic loading or stretching of the muscles involved in the exercise.

The muscles are pre-loaded with eccentric contraction before a powerful concentric contraction.

Plyometrics help to improve muscle power in the later stage of rehabilitation.

Examples are box drop jumps, bounding and hopping.