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ACL Surgery:

4 Detailed Program of Progressive Rehabilitation Exercises

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4 Detailed Program of the Progressive Rehabilitation Protocol for ACL Reconstruction

This guide describes the detail of the progression through the rehabilitation following ACL ligament reconstruction and should be read in conjunction with the other detailed guides from Mr. Johnson:

- 1 Anterior cruciate ligament reconstruction and the principles of ACL rehabilitation.
- 2 The surgical procedure and early rehabilitation of ACL ligament reconstruction.
- 3 Specific rehabilitation exercises for ACL ligament reconstruction.
- 4 Progressive rehabilitation protocol for ACL ligament reconstruction : Outline and Overview.

It is very important that patients take responsibility for their own rehabilitation, doing home exercises several times every day. Ask for help, advice or assistance, if you are not progressing as you would like to, or if you have any problems, from your physiotherapist, GP or Mr. Johnson. This guide is an outline for a standard ACL reconstruction patient in normal circumstances. It should be used in conjunction with advice from your physiotherapist and Mr. Johnson. Patients having more complicated or revision surgery will be advised to modify the protocol accordingly.

Evidence Based ACL Reconstruction Rehabilitation Protocol :

STAGE ONE

The aims of Stage One treatment are:

- Improve knee muscle control and obtain a sustained quadriceps, VMO and hamstring contraction by 48 hours.
- To enable full weight bearing and mobility by 48 hours, daily activities and stairs and office work safely by 1 week.
- To decrease swelling and promote movement. Increase the range of motion as tolerated to reach 60° by 1 week 80° by 2 weeks.
- To promote hamstring and quadriceps strength commensurate with normal function in the activities of daily living.

Stage One: Weeks 0-1

Aims	Treatment options
Minimise pain and swelling	<ul style="list-style-type: none"> • Intermittent cryocuff / ice • Elevation • Compressive tubigrip bandage • Regular analgesia • NSAID's whilst an in-patient
Increase muscle control <div style="display: inline-block; vertical-align: middle; margin-left: 20px;"> Quadriceps Hamstrings Calves </div>	<ul style="list-style-type: none"> • Quadriceps & VMO contractions, twitches and SLR exercises • Hamstring contractions • Prone knee bends, co-contraction • Calf raises • Static quads, mini squats, step ups
Mobilise	<ul style="list-style-type: none"> • Standing and walking in brace with crutches. • Discard crutches at 48 hours. • Gait education
Obtain full knee extension	<ul style="list-style-type: none"> • Rest in full extension with heel raise lying and sitting • Active hamstring assisted extension • Static quadriceps in extension • Prone heel hangs • Straight leg raising exercises • Full extension when walking • ROM brace locked in extension at night
Initiate range of knee flexion	<ul style="list-style-type: none"> • Active flexion, heel slides • Sitting bend • Wall slide
Proprioception	<ul style="list-style-type: none"> • Weight transfer, balance board • Static quads, mini squats, step ups

Management in the first few days:

- The knee is braced in a ROM brace set at full range on return to the ward.
- Antibiotics: iv Cefuroxime, for three does.

- Pre-emptive and postoperative multimodal pain management: paracetamol, opiates, diclofenac and local anaesthetic.
- DVT prophylaxis: early foot and leg exercises and mobilisation.
- Swelling control: Aircast Cryocuff (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 static quadriceps exercises.
- When patient returns to ward initiate gentle flexion, extension and SLR exercises. If this is particularly painful reduce exercises, ice 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 uncomfortable).
- As the patient gains confidence try this holding on to a solid object (washbasin) and progress supervised to the same with the eyes closed. Patients should be able to do this by second day post-operatively.
- 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.
- Patella mobilisation: teach self-treatment exercises and how to relax quads when doing this.
- Discontinue any exercise that causes unexpected pain and discuss with the physiotherapist or surgeon.
- Discharge from the hospital, if progressing well, on morning after operation or alternately following day.
- Continue to regain full extension with straight leg and closed kinetic chain exercises
- 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.
- Flexion exercises: wall and heel slides. Aim for 90° 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. This is usually at 48 hours following surgery.
- Contact your physiotherapist if you have problems with your knee or exercises.
- First physiotherapy follow up appointment should be at 7-10 days following surgery and weekly thereafter.
- First review by Mr. Johnson is 3 weeks following surgery.

Criteria progression for next stage:

- Progressive knee flexion to 40° and beyond.
- Full or near full knee extension
- Minimal pain and swelling controlled with analgesia only
- Concentric and eccentric quadriceps and hamstring muscle control in available range

References:

Corry et.al (1999),
Shelbourne et.al. (1992,1997, 1998,1999),
Risberg et.al. (2004),
Ejerhead et.al. (2003,2004),
Pinczewski et.al. (2002),
Howell et.al. (1998),
Yunes et.al. (2001),
O'Neill (1996)

STAGE TWO – Weeks 1 - 4

The aims of Stage Two treatment is:

- To eliminate swelling reduce analgesia to an as required basis.
- To promote progressive movement to 90° swelling and promote movement. Increase the range of motion as tolerated to reach 100° of knee motion by 4 weeks.
- To promote increasing hamstring and quadriceps strength commensurate with a weight bearing exercise program.
- To return to a function weight bearing predominantly closed chain exercise program.
- Return to sedentary work, driving and home / gym exercise program.

Stage Two: weeks 1-4

Aims	Treatment options
No pain or swelling	<ul style="list-style-type: none"> • Intermittent cryocuff / ice • Compressive tubigrip bandage • Regular analgesia • Use pain and swelling as a guide to progression of rehabilitation
Increase muscle control Quadriceps Hamstrings Calves	<ul style="list-style-type: none"> • Closed chain in less than 60° flexion, squats, step up/down/side, lunges, leg press, bilateral to unilateral as able. • SLR as directed. • Open chain in more than 40° flexion from 6 weeks • Curls, prone knee bends, bridging, progress weight as able • Calf raises, unilateral, add weight
Maintain muscle length	<ul style="list-style-type: none"> • Muscle stretches
Maintain full knee extension	<ul style="list-style-type: none"> • Rest in full extension with heel raise lying and sitting • Active hamstring assisted extension • Static quadriceps in extension • Prone heel hangs • Straight leg raising exercises • Full extension when walking • ROM brace locked in extension at night
Improve range of knee flexion to 120°	<ul style="list-style-type: none"> • Active flexion, heel slides • Sitting bend, bottom slide. • Wall slide • Assisted flexion • Accessory mobilisations – TFJ,PFJ • Static bike
Function	<ul style="list-style-type: none"> • Normalise gait, style, strength etc • Static bike • Driving
Graft protection	<ul style="list-style-type: none"> • Avoid jogging, swimming, gym, twisting or active open chain exercises. • Minimise weight bearing rotational forces

Stage two progressive exercise program.

Continue all stage one exercises.

Sit to stand: Use different chair heights to make this exercise more difficult. The lower the chair the more difficult the exercise.

Wall squats: Stand with back against the wall, legs straight. Slowly slide down the wall until knees are bent to 90°.

Step Ups Place operated leg on to a 3cm step. Keep weight on the outside of the foot, and knee pointing out over the 2nd and 3rd toes. Bring the weight on to the operated leg and slowly straighten the knee by contracting VMO. Slowly lower the opposite leg until the foot is on the ground.

Step Downs: Stand on the step with your weight on the affected leg. Your toes should point forward, knee rotated outwards. Slowly step down, concentrate on contracting VMO and controlling the movement. Return slowly to the starting position and repeat.

Theraband Start with the theraband around the knee, rotate the leg outwards and away from the other leg. In the lying or sitting position, place the theraband around the ankle and slowly bend knee against the resistance of theraband before returning to the resting position. In standing, perform the exercises below with the theraband around the unoperated leg. Use core stability with the VMO and hamstring muscles to control the position of the operated leg whilst moving the other leg. Keep stomach and buttock muscles tight to stabilise the pelvis when performing these exercises.

Balance work and proprioception

- Balance on operated leg, ensure all the muscles around the hip and thigh are contracting.
- As above but maintain balance while moving arms.
- Balance with eyes closed.

Wobble board: When confident standing on one leg with eyes closed, progress to the wobble board. Start with two legs on the board, evenly spaced. Rock the board backwards and forwards and side to side. Attempt to balance with the rim off the ground.

Pilates ball: Sitting on a large pilates ball up against a wall with your knees bent and both feet firmly on the ground. Move the ball with your bottom using both legs to control the movement in a circle to the left and right. When confident do the same exercise holding the good leg off the floor. Alternately move the ball away from the wall and undertake the same exercises.

Abdominals: The stomach muscles are important as stabilisers in every lower limb activity. It is important to start controlled abdominal exercises. Lying on your back, hip and knees bent up to 90°. Gently raise your head and neck off the floor, your mid to lower back should remain in contact with the floor.

Static bicycle: Use initially with a high seat and no resistance for short durations. Once the leg can be circumducted on the peddle the seat can be progressively lowered to promote more knee bend. If the exercise can be undertaken without pain and swelling then progressively longer periods and greater resistance may be used.

Hydrotherapy: Pool exercises can be undertaken from 2 weeks provided the sutures have been removed and the wound is dry and sealed, there are safe steps for entry and exit from the pool and if only gentle hydrotherapy movements are used. Swimming is not included until phase three.

Criteria for progression to stage three:

- Pain free, minimal use of analgesia and no swelling
- Full range of movement from full extension to 120°
- Full muscle control throughout functional activities.
- Normal full weight bearing gait without support or brace.

References:

- Risberg et.al.(2004),
- Shelbourne et.al.(1999),
- Beynon et.al. (1997),
- Morrissey et.al. (2000),
- Steinkamp et.al.(1993),
- Heller et.al.(2003),
- Ross et.al.(2001),
- Synder-Mackler et.al.(1995), O’Neill (1996)

STAGE THREE – Weeks 4 - 12

The aims of Stage Three treatment is:

- To use NSAID’s occasionally to facilitate rehabilitation and control reactive swelling.
- To achieve a full range of knee flexion to full squatting position.
- To return to all daily activities, walking, driving, housework and gardening. Return to putting and chipping at golf.
- To return to more active work including light manual work and work on uneven surfaces.
- To return to a function weight bearing open and closed chain exercise program.
- To promote a return to a regular gym-strengthening program, with local and general muscular strengthening and initiate sports specific conditioning.
- Prepare for jogging programme by increasing strength and stability

Stage Three: weeks 4 – 12

Aims	Treatment options
Pain and swelling control	<ul style="list-style-type: none"> • Intermittent cryocuff / ice • Compressive tubigrip bandage for exercise. • Risk of swelling with load and exercise progression controlled with NSAID’s • Use pain and swelling as a guide to progression of rehabilitation
Improve muscle strength	<ul style="list-style-type: none"> • Progress with static cycling, strengthening exercises, • gym weights • controlled rotational stresses, endurance
Maintain full range of movement	<ul style="list-style-type: none"> • Continue static cycling program • Continue bottom slides and squat exercises. • Continue full knee extension stretches.
Improve proprioception	<ul style="list-style-type: none"> • Introduce dynamic exercises, hopping. • Trampet bouncing • Pilates • Single leg dips, squats and wobble board exercises
<p>Function</p> <p style="padding-left: 40px;">Daily activities</p> <p style="padding-left: 40px;">Gym</p>	<ul style="list-style-type: none"> • Driving • Walking, gardening, • Light manual work on level surfaces. • Swimming with gentle crawl leg kick • Static cycling with increasing duration and resistance. • Rowing, stepper, Nordic walker, cross

Sports specific	<p>trainer exercises</p> <ul style="list-style-type: none"> • Weights avoiding resisted leg extensions. • Golf putting / chipping • Static tennis.
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Functional activities

Body awareness: Progress to a more difficult wobble board exercises: eg single leg balance on wobble board or trampoline.

Mini-tramp: Only start this if knee control is good. Heel and toe standing balance (both feet). Single leg balancing exercises, and single leg dip using VMO and hamstring muscles for control.

Gymnastic ball: Put both heels on the large ball. Lift buttocks off the supporting surface and keep them off during this exercise. Rock the ball towards you, then away. Walk the ball towards you then away. Stand with the unaffected leg on the ball, ensure the operated leg muscles are contracted. Move the ball towards you and away.

Side slide or ski-trainer (Reebok): With the feet evenly placed side by side. Use the leg muscles to control the swing evenly and smoothly from side to side.

Swimming: Use a float between the legs for upper body strengthening and aerobic fitness during the early stages of rehab. Commence jogging in waist deep water from 8 weeks. Continue to swim front crawl or backstroke until 12 weeks.

Cycling: Continuing static cycling slowly increase resistance and duration of exercise.

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). In all cases the patient must decide when they are fit to drive. Common advice is that this can usually be expected after approximately 4 weeks.

Flying: There is no universal agreement as to when it is safe to travel by plane after an ACL reconstruction. Most Orthopaedic Surgeons advise their patients not to fly for 4 to 6 weeks following the ACL reconstruction. Short flights are of less consequence. Longer 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 could predispose to the development of deep venous blood clots, especially in people following recent knee surgery. Drinking alcohol and dehydration accentuate the problems, whilst drinking water, use of compression stockings and regular walking during the flight reduces the risk. In males a small dose of aspirin prescribed by your GP may also help reduce the risks.

- At 1-4 weeks: patients are usually able to return to sedentary work, at 6-8 weeks to light manual work and by 8 weeks to heavy work.
- Continue with weekly-supervised physiotherapy sessions.
- If you have patella problems of clicking, grinding, pain or stiffness try patellar mobilisation exercises.
- Patients should have achieved a full range of knee extension with the knee being as straight as the other side after 4 weeks.
- The range of knee flexion should be at least 90° and hopefully 120° by 4 weeks with a full range of 130° by 8 weeks.
- At 6 weeks 2nd follow-up by Mr. Johnson.

Criteria for progression to stage four:

- Pain free without use of analgesia or NSAID's and no swelling
- Full range of movement from full extension to 130°
- Full muscle control throughout exercise, light impact and rotational activities.
- Normal gait during exercise.
- Adequate level of achievement, strength and endurance during exercise in a straight line.

References:

Risberg et.al.(2004),
Shelbourne et.al.(1999),

STAGE FOUR – Weeks 12 - 26

The aims of Stage Four treatment is:

- To maintain full function in daily activities.
- To progress on a gym program to strengthen quadriceps and hamstring strength to 90% of good side in preparation to return to full sports.
- To engage in high level balance, proprioceptive training including hopping, skipping and same spot jumping.
- To initiate a controlled and progressive running program to reach figure of 8, circle and shuttle running by 26 weeks.
- Sports specific preparation prior to returning to non-contact soccer, rugby and hockey field sports and basketball, tennis and squash court sports at 26 weeks.
- Return to gentle non-contact straight-line sports such as jogging, golf, rowing, outdoor cycling, normal swimming and an unrestricted gym program.

Stage Four: weeks 12 – 26

Aims	Treatment options
Pain and swelling control	<ul style="list-style-type: none"> • Intermittent cryocuff / ice • Occasional risk of reactive swelling with load and exercise progression controlled with NSAID's
Improve muscle strength	<ul style="list-style-type: none"> • Full gym, swimming and weights strengthening program. • Lunging, hopping, skipping exercises. • controlled rotational stresses, endurance
Maintain full range of movement	<ul style="list-style-type: none"> • Observe to ensure full ROM is maintained.
Improve proprioception	<ul style="list-style-type: none"> • Active dynamic jumping, skipping exercises • Twisting and shuttle running.
Function Daily activities Gym Sports specific	<ul style="list-style-type: none"> • Unrestricted • Normal swimming program • Normal cycling program. • Full unrestricted weights and gym exercises • Normal Golf • Static tennis, badminton, squash. • Static jumping in basketball • Gentle 25 metre ball kicking in soccer and rugby.

Returning to jogging and running following ACL reconstruction:

Running may be commenced at 12 weeks. Running involves impact forces across the knee and strain to the ACL reconstruction. To withstand this activity safely the graft needs to be well anchored in its tunnels, the graft tissue mature and the knee protected by adequate muscle strength, proprioception and the body's protective reactions. In order for this to be a safe activity patients must have full knee extension, good quadriceps power and control, good balance and body awareness. Your physiotherapist will tell you when you are ready to start this programme. Do not run up or down hills until well into the running program particularly following use of a BPTB graft.

1. Start with brisk walking (7-8 minutes per km), building up to 1km in 7 minutes.
2. Alternate jogging and brisk walking at 100 metre intervals. Slowly over a week build up to 2-3km.
3. Slowly increase the walk/run until you are running 500m at a time.
4. Increase jogging to 1-2km on alternate days. Ice the knee after running for the first few weeks.
5. Progress from ½ pace to ¾ pace to full pace in a straight line. Increase distances of full speed running from 100m, 200m to 800m.
6. Progress to running 5-8km as would be normal for your training program. You must build up running endurance before agility drills can be commenced.
7. Running may be alternated with swimming, rowing and cycling to build up endurance.

Return to jumping sports following ACL reconstruction:

Start hopping and jump downs, ensure good hamstring contraction and good knee control on landing. Start with a 10cm step and build up to 40cm step. Progress to single spot jumping on a level surface: eg basketball shooting gym. Progress to forward / backward and sideways double footed jumping and then finally to single legged jumping/hopping in all directions.

Agility training following ACL reconstruction:

A very important part of the rehabilitation is the final stage of balance / proprioception training. In this the body's own reactions and protective mechanisms are retrained before return to competitive twisting or pivoting sports. This agility training should be gradually introduced as the running program progresses towards 26 weeks. The full agility program should be achieved with some competence and speed before returning to full twisting sports training. The progressive exercises include the following and can be interspersed with the jogging and running program:

- Jogging in large circles, increasing pace.
- Jogging in narrower and shorter circles, increasing pace.
- Jogging in large to small figure of 8's, increasing pace.
- High knee running, backward running and zigzag running.

After 26 week the following exercises can also be incorporated:

- Shuttle runs
- Side steps (off balls of feet).
- Crossed side step running (cariocas)
- Zigzag hop.
- High leaps
- Running stairs
- Agility

Criteria for progression to stage five: Unrestricted sports:

- Pain free without use of analgesia or NSAID's and no swelling
- Full range of movement from full extension to 130°
- 90% of normal side strength and endurance in hamstrings and quadriceps muscles.
- Normal running gait.
- Adequate level of achievement, strength and endurance during shuttle running, twisting, jumping and proprioception exercises.
- Objectively stable knee on clinical testing with negative Lachmann, anterior draw and pivot shift test.
- Cardiovascular fitness of pre-surgery level.

References:

Risberg et.al.(2004),
Shelbourne et.al.(1999),

STAGE FIVE: unrestricted sports after 26 weeks

The aims of Stage Five treatment is:

- To return to twisting sports in a non contact manner.
- To acclimatise to the sports surface and speed together with twisting and jumping.
- To avoid further injury from unexpected contact, uneven landing or an unexpected blow to the legs whilst running.
- To complete the agility training program and full proprioception rehabilitation.
- To return to contact sports safely: For non professional athletes 9 months is recommended.

Skiing: Due to the large rotational forces involved skiing should not be attempted for 9-12 months. For skiing it is recommended that you wear a knee brace, your physiotherapist will advise. This will not provide absolute protection but will remind you at all times to ski carefully, under control and to avoid the risk of re-injury.

Sports specific training: The emphasis is on the detailed technique of the particular sport, endurance and accuracy. You need to practice and perfect any special skills you need for your sport. This may include ball skills, kicking, throwing or catching.

- You should ensure that the strength of the operated leg is within 10% of the other leg, and full range of movement is normal, full activity may be resumed.
- You should have completed the agility training program.
- You should discuss with your consultant or physiotherapist when you can return to competitive sport.

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