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ACL Surgery:

3 Specific Rehabilitation Exercises

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3 Specific Rehabilitation Exercises for ACL Reconstruction

General management of rehabilitation

Exercises should be undertaken regularly. This should include some exercise every hour and a more defined 30-minute session perhaps 4 or 5 times a day. The scheduling of analgesia or pain medication should be adjusted so that it is perhaps 30 minutes before an exercise program. If anti-inflammatory medication has been prescribed then this too may be taken perhaps 30 minutes prior to an exercise session. Icing with an ice-pack or bag of frozen pees is essential for 10 minutes following exercise to control any effect on swelling. Exercises may cause some discomfort but should not cause pain or significant swelling in the knee.

Open and Closed Kinetic Chain Exercises

Open kinetic chain exercises involve the knee being fixed and the foot moving, often against resistance (eg knee extensions in the gym, kicking a football, etc). All exercises create stress within the ACL graft, Closed chain exercises in general cause less stress on the new graft. Straight leg raising exercises are open chain but promote little stress on the ACL only equivalent to 200N or level walking. This is a safe and useful exercise in the early rehabilitation of ACL reconstruction. The strength of graft fixation in Bone-Patellar-tendon-Bone grafts using screws is such that active straight leg raising exercises can be undertaken immediately. Where a hamstring graft has been used the fixation is a little less secure, please consult Mr. Johnson as to when open chain straight leg raising exercises can be begun.

Quadriceps and hamstring activation exercises

Following ACL reconstruction it is a natural response for the body to inhibit the activity of both the hamstring and quadriceps muscles. This occurs in both types of ligament reconstruction. Obviously the hamstring weakness is greater where the hamstring tendons have been harvested and used to replace the ACL. Where a section of patellar tendon has been taken from the front of the knee quadriceps weakness and pain is more prevalent.

These muscles must be reactivated and used when exercising and mobilising. Good muscular control is essential for safe mobilisation and provides support to the reconstructed ACL.

Quadriceps activation: If a good straight leg raise is present then a good level of activity is already present . Where this is not possible or allowed patients should be asked to contract the quadriceps to make is stand out and compared to the other side. Often wasting of the bulk of the muscles was present prior to surgery but often little or no contraction is possible. Patients should work at alternately contracting and relaxing the muscle and then progressing to straight leg raising or knee extension exercises as described below. In addition a rapid twitch of the lower quadriceps can be demonstrated on the good knee that causes a twitch of the patellar or knee cap. This should then be encouraged and achieved on the operated leg. This reactivates the muscle and provides some control in respect of contraction and relaxation. These exercises should be repeated with the leg rolled out so that the medial or inner part of the quadriceps is used and also with the leg rolled inwards so that the lateral quadriceps muscles are used.

Hamstring activation: Where the hamstring tendons have been harvested there may be significant weakness of the hamstring muscles. If both the semi-tendinosus and gracilis tendons have been used patients may not be able to lift the foot off the floor behind them for several weeks. However the hamstring should be activated in the early phase of recovery. This is achieved by using the hamstrings with the leg straight in the sitting or lying position to press the heel into the bed or couch. The knee may be allowed to bend perhaps 10°. This contraction should be maintained for increasing amounts of time from 3 seconds to 5 and 10 second periods before relaxing. The exercise may need to be demonstrated using the good leg. This exercise should be repeated with the leg rolled out so that the lateral or outer part of the hamstrings are used and also with the leg rolled inwards so that the medial hamstring muscles are used.

EXTENSION EXERCISES: Knee straightening

Knee extension exercises are essential in the early rehabilitation to ensure full knee extension is regained as soon a reasonably possible. Extension exercises may be undertaken on patients with a Bone-Patellar-tendon-bone ACL graft from immediately following surgery and usually following hamstring tendon reconstruction. In the immediate post operative period the following exercises should be used regularly: A(a), A(b), B(a), B(b), C, and D(a), D(b).

A. Passive extension: Lie flat on your back with a rolled up towel or support under your heel.
    a. Allow the leg to hang with the toes pointing to the ceiling. This allows the knee to slowly straighten over a period of 3-5 minutes.
    b. In the same position after 3-5 minutes use the hamstring muscles to straighten the knee forcing the heel into the support and straightening the knee as far as possible.
    c. When shown and demonstrated by Mr. Johnson or your physiotherapist push down with your hands on the front of the knee forcing the knee further straight.
    d. In the same position when demonstrated have someone gently but firmly press over the front of the knee helping the knee to gently and firmly straighten. Apply and release the force gently so as not to cause pain, apprehension or resistive muscle reaction.

B. Leg hanging lying: Once the knee is in the position of full extension lying on your back with a rolled up towel or support under your heel.
    a. Lift the leg in a straight leg raise. Hold the heel off the bed or support and hold this position for 3 seconds before gently lowering the leg. Repeat the exercise 3-5 times.
    b. Undertake the same exercise with the toes pointing not towards the ceiling but rotated outwards by 30 degrees.

c. As muscle strength increases the above exercises can be undertaken but whilst kept raised the knee can be bent 20 degrees before being straightened again before repeating and then lowering the leg to rest on the bed again.

C. Leg hanging sitting: The above exercises should be repeated in the sitting position with the knee resting on a stool.

D. Leg hanging in prone position: Lying on your front with the foot extending over the end of the couch or bed.
   a. Allow the leg to hang with the toes pointing to the floor. This allows the knee to slowly straighten over a period of 3-5 minutes.
   b. In the same position after 3-5 minutes use the quadriceps muscles to straighten the knee forcing the heel down towards the ground and straightening the knee as far as possible.
   c. When shown and demonstrated by Mr. Johnson or your physiotherapist have someone gently but firmly press over the heel helping the knee to gently and firmly straighten. Apply and release the force gently so as not to cause pain, apprehension or resistive muscle reaction.

EARLY FLEXION EXERCISES: Knee bending exercises

Simple knee flexion should be started immediately following surgery. When lying in the bed the knee can be bent and then extended back to a resting position. Usually a range of knee flexion of 30°-50° is possible on the first day. Once able to sit up comfortably the knee can be allowed to flex over the side of the bed. If the knee is painful to lift then the other leg can be used to lift the operated leg over the side of the bed. If the toes of the good leg are placed under the ankle of the bad leg and then used to help lift the leg over the side of the bed. Then slowly the knee can be allowed to bend perhaps 50°-70° degrees. From this position knee extension (straightening) to some degree is usually possible.

Mobilisation and walking: Once this degree of muscular control is achieved then safe mobilisation and walking is possible. This should be accompanied initially by a physiotherapist or nurse and may require the use of crutches. Patients receiving a hamstring graft reconstruction tend to be less uncomfortable and require less analgesia or pain relief. Some patients who are mobile safely on crutches with good pain control may be discharged from hospital within 24 hours. For most patients and where a bone-patellar tendon-bone graft has been used a one or two night stay in hospital is more usual.

The crutches may be discarded when advised by the physiotherapist usually within 2-4 days although they may be useful when walking outdoors for a little longer.

Braces: A post-op range of motion knee brace may be used for support. This is usually set to allow a full range of motion. The success of the reconstruction procedure is entirely dependant upon proper positioning and tension in the graft. The initial fixation particularly when a hamstring graft has been used is vulnerable and the weakest part of the reconstruction. A brace is therefore often provided to protect the knee and provide some stability in the first few weeks of mobilisation. It may be removed for cleaning and when undertaking exercises or physiotherapy. It is sometimes useful to lock the brace in extension with the knee straight at night for the first few weeks as this promotes and maintains full knee extension and facilitates mobilisation in the mornings. When a more complex revision procedure has been undertaken to reconstruct the ACL, this post-op knee brace may be exchanged after 3-4 weeks for an ACL stabilising brace, which will protect and support the graft throughout the rehabilitation period. Such a brace is also used when returning to manual work to provide additional support in the early phase of rehabilitation.

FLEXION EXERCISES: Knee bending exercises

After the first few days when pain and discomfort has settled, the swelling has reduced and patients are walking comfortably more progressive knee flexion exercises can be begun. These exercises include:

a. Foot slide: Sit on a chair with your foot straight out in front of you. Slide your foot along the floor towards you using your hamstring muscles.
b. Sitting bend. Sit on the edge of a bed or table with the leg hanging off the ground. Gently relax the quadriceps muscles (thigh muscles) to allow the knee to gently bend. Try consciously relaxing the quadriceps muscles to allow slightly more knee bend on

each occasion. Using your quadriceps muscles gently straighten the knee again before repeating the exercise.

c. Wall bend. Lie on your back with your leg out straight against the wall. Gently slide your leg down the wall until it is bent. Return your leg to the start position using your hands.

d. Bottom slide: For patients who are two or three weeks following surgery this is Mr. Johnson's preferred exercise for promoting a good knee bend. Patients should sit in a high chair or dining chair with the foot resting on the ground. The knee should be actively bent sliding the foot along the floor or carpet as in a "Foot slide" exercise. When the maximum amount of knee bend has been achieved with both knees bent and the feet flat on the floor. The patient then needs to use their hands to lift their bottom a little off the chair. The patient then moves their bottom forwards perhaps five centimetres towards the front of the chair before sitting in that position. In this way the patients body weight is used to achieve a few further degrees of knee bend. After the position is held for a period of 10 seconds the arms can be used again to return to a position further back in the chair.

In the first few days some occasional patients have pain, which restricts their mobility and comfort, then a Continuous Passive Motion Machine (CPM) may prove useful. It is often used at a range of 40° of knee bend and progressively the range is increased to 90° over the first few days. Most patients do not require and do not benefit from the use of a CPM machine.

KNEE CAP MOBILISATON

The tissues around the patellar can become swollen tight and scarred. This is more prevalent following use of a BPTB ACL graft. In these patients it is important to promote and maintain normal mobility of the patella. In this exercise sit with legs out in front. It is essential to encourage and promote quadriceps relaxation. Use your thumbs on the outside of your kneecap to push it across firmly to the inside. Hold for 5-10 seconds then slowly release. Repeat this 5 times. The exercise should be repeated with equal enthusiasm pushing the kneecap to the lateral or outside by pressing with your thumbs to the inner side of the kneecap. This should also be repeated pushing the kneecap upward and downward to encourage all round patellar mobility.

VASTUS MEDIALIS OBLIQUE (VMO)

The VMO muscle is inner most or medial aspect of the lower quadriceps muscle to the inner side of the lower thigh. This muscle helps to control the position of the kneecap. Post-operative swelling and pain quickly reduce the function of the muscle. The following exercises are aimed at activating and strengthening this muscle.

Quadriceps activation: As described above the quadriceps activation exercises should be undertaken encouraging good quadriceps twitch and a sustained contraction with the leg rotated outwards so that the inner or medial aspect of the quadriceps is used.

Mini leg press: Sit with foot out in front of you pressed up against the wall. Bend the knee perhaps 20° and push back to the straight position.

VMO exercises with the knee flexed: Roll thigh outwards with a pillow or rolled up towel under your knee. The aim is to contract the VMO while the rest of the quadriceps stays relaxed. Dig your heel into the bed contracting the hamstrings, then contract the inner thigh. Hold the contraction for 5 seconds then repeat. Build up to a 10 second contraction.

VMO exercises in the lunge: Stand with affected leg forward and slightly bent. Keep your toes pointed directly forward, and rotate your leg to turn your knee cap outward. Arch your foot, tighten the hamstrings by attempting to pull the heel back along the floor (without actually letting it move). At the same time contract the VMO on the inner thigh, while relaxing the outer thigh muscles. Hold each contraction for 5-10 seconds, rest then repeat this exercise.

GENERAL STRENGTHENING EXERCISES

As rehabilitation progresses general exercises, fitness and strength are important. Restoration of the normal gait or walking cycle, posture and function depends not just on the knee. Other exercises to be introduced in the period of 2-4 weeks following surgery include:

Lying hamstrings: Lie on your stomach. Bend the operated leg slowly up towards the buttock as far as it will go and then lower gently back to the resting position. Control the speed of the movement on the way up and down.

Sitting hamstrings: Sitting with your leg out in front of you. Gently slide your foot towards you, use theraband or an elasticated exercise band around your ankle to make this exercise more difficult.

Quadriceps: Sit with the knee bent at 90°. Straighten knee to 50°, hold then slowly lower.

Straight leg raises: This open chain exercise can be undertaken initially for patients with BPTB ACL reconstructions but you will be advised when it is safe to start this exercise in patients having a hamstring type ACL reconstruction. In the lying position lift the straight leg 30cm from the bed or couch, hold for 10 seconds before gently lowering, rest and repeat. Patients should be encouraged to progress rapidly to undertaking the exercise in the sitting position.

Leg adduction; Lie on the operated side with good leg bent over in front of the operated leg. Lift the operated leg off the ground, and try to tighten the VMO.

Leg abduction: Lie on the side with the operated leg uppermost. Keep leg straight and in line with the body (do not bend hip forwards). Lift leg 30cm. Hold for 3 seconds and lower gently, rest and repeat.

Hip extension: Lie on your stomach. Keep knee straight, tighten stomach muscles and lift the whole leg off the bed. Hold in this position for 3 seconds and then slowly lower to the resting position.

Hip extension with the knee bent: Undertake the exercise as described above with the knee bent . Hold for 3 seconds, lower rest and repeat.

Bridging: Lying on your back lift your pelvis up off the floor, (your shoulders and arms remain in contact with the floor). Progress by using only the operated leg to lift your pelvis off the floor.

Calf raises: Whilst standing, holding on to a support, keeping your knees straight, slowly rise up on to your tip toes. Slowly lower, rest and repeat. Patients should be encouraged to progress to using only the damaged leg. Ensure that the knee is kept straight during the exercise.

Wall slides: Whilst standing with your back flat against a wall with both feet flat on the ground perhaps 30cm away from the wall. Slowly allow the knees to bend sliding your back down the wall and back up to the resting position. Initially the knee should be allowed only to bend perhaps 20°-40°. After 4 weeks a range of 60° should be achieved and after 6 weeks a deep knee bend to 90°. Patients should be encouraged to progress to only using the operated knee for support during the exercise.

Dips and single leg dips: Whilst standing, holding on to a support. Slowly allow the knees to bend hold the position for a second and straighten back up to the resting position. Initially the knee should be allowed only to bend perhaps 20°. After 4 weeks a rage of 40° should be achieved and after 6 weeks a deep knee bend to 60°. Patients should be encouraged to progress to only using the operated knee for support during the exercise.

Squats: These should be undertaken in a similar way to the Dips exercise using both legs but with the feet apart and the toes and knees pointing outwards.

Step up and step down exercises: This exercise should initially be undertaken in the 2-4 week post-operative period using a small step of 10-15cm. A step aerobics step is ideal. Step up and step down exercises should be undertaken using both legs. A gently slow and controlled movement is required

controlling the quadriceps action throughout the exercise. The exercise should be undertaken for perhaps 5 minutes 4-5 times a day.

Static exercise bike: The static exercise bike is a very useful tool for rehabilitation. Even if patients do not have the required degree of knee flexion for a complete circumduction of the pedal swinging the pedal encourages knee flexion. With the saddle high patients can be encouraged to achieve circumduction over the first 2-4 weeks. Then in each progressive day the saddle can be lowered to encourage an ever-increasing degree of knee flexion. The exercise is closed kinetic chain and therefore applies little strain to the reconstructed ACL graft. Once circumduction is achieved the bike may be used for general exercise and leg straightening. This should initially be for short 5 minute sessions with no resistance. If pain or swelling occurs then too much exercise had been undertaken. If comfortable then progressively the duration and resistance can be increased each day.

Rowing machine: The rowing machine is a closed kinetic exercise and therefore applies little strain to the reconstructed ACL graft. This exercise should be used after perhaps 2-4 weeks, initially be for short 5 minute sessions with no resistance and limited 30° knee bend. If pain or swelling occurs then too much exercise had been undertaken. If comfortable then progressively the duration, resistance and degree of knee bend can be increased each day.

Nordic walking: Whilst standing, holding on to a support, the Nordic walker is a good closed kinetic chain exercise to improve the style, strength and style of walking or gait. This exercise should be used after perhaps 2-4 weeks, initially for short 5 minute sessions with no resistance and limited 30° knee bend. If pain or swelling occurs then too much exercise had been undertaken. If comfortable then progressively the duration, resistance and degree of knee bend can be increased each day.

Cross trainer: This exercise demands a greater degree of core stability, balance and strength. The exercise should therefore be delayed until 6-8 weeks following surgery. Ensure that you have the necessary degree of knee flexion for the use of this machine before using. The machine should be used whilst standing, holding on to the handles for support using a minimum of resistance. This exercise should not be started until 6 week following surgery. Its should be used initially be for short 5 minute sessions with no resistance and limited 30° knee bend. If pain or swelling occurs then too much exercise had been undertaken. If comfortable then progressively the duration, resistance and degree of knee bend can be increased each day.

Stepper: Use of the stepper machine demands a greater degree of core stability, balance and strength. In addition the exercise places a considerable strain on the patellar tendon. Where a BPTB ACL reconstruction has been performed this exercise should be undertaken gently with little or no resistance for the first 8 weeks following surgery. With a small cadence and low resistance. Use of the stepper machine should therefore be delayed until 6-8 weeks following surgery. Before using ensure that you have the necessary degree of knee flexion for the use of this machine. The machine should be used whilst standing, holding on to the handles for support using a minimum of resistance. The exercise should be used initially for short 5 minute sessions with no resistance and limited 30° knee bend. If pain or swelling occurs then too much exercise had been undertaken. If comfortable then progressively the duration, resistance and degree of knee bend can be increased each day.

PROPRIOCEPTIVE EXERCISES FOLLOWING ACL RECONSTRUCTION:

Balance and proprioceptive training are very important components of an ACL rehabilitation program. Balance is important for stability and avoiding further injury. The balance or proprioceptive sensors in the ligament are damaged following knee injury, during periods or knee instability and following ACL reconstruction. The position sense and balance has to be retrained. Progressively the body's protective reflexes also need to be retrained before return to full function and sport. It is the final achievement of 90% of normal strength and full balance and proprioceptive reflexes that determine when a patient can return to sport.

One leg standing: These exercises can be undertaken from the first day following surgery. 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 or 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. Try to put your socks on whilst standing on the other leg.

Wall stand: Whilst standing on the operated leg, with your eyes closed. Use a single finger to touch a wall whilst slowly moving your body in a circle around your core axis. Repeat the exercise whilst standing on the operated leg whilst it is bent perhaps 20°.

PILATES EXERCISES IN ACL REHABILITATION :

Pilates exercises are a series of exercises which were specifically designed for dancers. The exercises concentrate on ‘core stability’. This is strengthening and stability of the central muscles in and arround the spine, pelvis and shoulder girdle. The exercises increase flexibility, strength and balance or proprioception which is very important in the rehabilitation of ACL injuries. The exercises are generally quite complicated and instruction from your physiotherapist or Pilates instructor may be required. Generally these exercises can be started 4-6 weeks following surgery.

Pilate’s one leg stretch: Lying on your back with the knees bent and slightly apart and the feet flat on the floor. The abdominal and pelvic floor muscles should be slowly contracted whilst one leg is straightened along the floor and then slowly bent again. The other leg should then be used followed by a rest in the relaxed position before repeating.

Pilate’s ball exercises : Place a large 80cm diameter pilates ball against a wall. Standing in front of the ball with your feet wide appart. Feel for the ball behind your with your hands. Stabilise the ball as you gently sit on the ball. Find a stable position. With your feet flat on the floor use your legs to balance. Progress to using your legs to slowly and steadily move the ball in a small circle away from the wall and back to the start. Repeat the exercise in the other direction. Progress to moving the ball away from the wall before starting. Finally undertake the exercise lifting the non-operated leg partially and then fully off the ground. Progress slowly. Balance and control from the operated leg will improve. Be careful not to fall off the ball, move too quickly or too far, and take care when getting on and off the ball.

Pilates shoulder bridge : Lying on your back with the knees bent a little distance apart and the feet on the floor. The abdominal and pelvic floor muscles should be slowly contracted whilst the pelvis is slowly lifted a little distance off the floor. Then slowly the lower back is lifted and then the chest so that the head, shoulders and feet remain on the floor. Slowly reverse the exercise back to the resting position. As strength and control increase over the weeks the exercise can be repeated and when in the bridge position the non-operated leg may be lifted off the ground leaving support and balance only from the operated leg. The good leg should be replaced before returning to the rest position. This should be attempted perhaps only after 6 weeks. With time the exercise can be repeated only using the operated leg throughout the exercise.

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