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Management and Rehabilitation of the Injured Anterior Cruciate Ligament Mini Series

Session Two: Rehabilitation in the Maximum/Moderate Protection Phase (0-12 weeks)

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Following anterior cruciate ligament reconstruction (ACLR), the 0-12 week rehabilitation phase can be further subdivided into maximum and moderate protection phases.

In the first two weeks following surgery (maximum protection), rehabilitation goals are wound healing, full extension, minimize any joint effusion and regain lower limb control.

Maximum Protection Phase

Effusion

The presence of oedema will have an inhibitory effect on ROM, strength, proprioception and ultimately function. The therapist should not ignore the presence of swelling in the hope that it will disappear as function begins to improve. The lack of extensive superficial wounds often encourages the athlete/therapist to progress too quickly; this is often the cause of any acute joint reaction.

Progressive Range of Movement (ROM) Knee Exercises

In the maximum acute protection phase, full knee extension is essential as soon as possible following ACLR.

These can be performed in various starting positions as the injury progresses from its acute stages: -

- Long sitting with heel resting on a slippery re-education board (Formica surface). A sheepskin pad can be placed under the heel to reduce friction even more. Knee flexion can be assisted further by placing a band around the foot, pulling on the band during knee flexion.
- Lying on back with feet up in the air, legs and bottom against a wall. Bend the knee, sliding the heel down the wall.
- Sitting on a stool, with foot resting on the floor. Knee flexion is assisted with a low friction floor surface and a sock on the foot.
- Supplementary Continuous passive motion (CPM) using a CPM or isokinetic unit may be useful in certain cases

Patella Mobilisation

- Long sitting with thumb and index finger either side of the patella. Move the patella, lateral to medial allowing the patella to return to its natural position. This ensures mobilization of the lateral structures of the patella, which often restrict glide of the patella.
- Long sitting with thumb and index finger either end of the patella. Move the patella, inferiorly allowing the patella to return to its natural position. This will maintain/correct patella orientation and in conjunction with vastus medialis oblique (VMO) exercises improves the timing and force of the muscular effect on the patella.

Strengthening Exercises

Emphasis during knee rehabilitation must focus on strengthening the controlling musculature throughout a range of motion that does not damage the already compromised joint. All therapists should follow the Overload principle when designing the appropriate rehabilitation programme. Intensity, frequency and duration are the 3 major components which must be adjusted as the patient progress' (or regress' sometimes) at approximately 2 week intervals. Self reflection is important on reassessment in case the demands for each individual patient are excessive. At the same time the unmotivated or lethargic patient needs to be pushed harder if failing to reach the required rehabilitation goals set out by the medical team.

Some of the most common exercises used in rehabilitation schedules for ACLR surgery are listed below and are discussed individually

- Quadriceps isometric exercises in prone lying, sitting and then progressing to the supine position are commenced immediately in the post-operative athlete. In the prehabilitation of an injured athlete these exercises may be too easy unless the individual has marked quadriceps wasting. From research this exercise produces most muscle activity in vastus medialis, biceps femoris and gluteus medius (Soderberg et al, 1987).
- Normally, the post-surgical patient will then progress to straight leg raises, initially using the weight of the limb and then a weighted boot or sandbag for resistance. It should however be recognised by the therapist that this exercise produces electromyographic (EMG) values for rectus femoris as well as the vasti muscle group (Gryzlo et al, 1994).
- Some overflow to produce muscle activity in the hamstring muscle group, in what are
 considered to be primarily quadriceps strengthening exercises, has been noted in various
 research papers (Gryzlo et al, 1994; Soderberg et al, 1987). Isolated and co-contraction
 hamstring work should be encouraged as the athlete progresses through the maximum and
 moderate protection phases of rehabilitation in the post surgical ACLR patient. However,
 following associated meniscal repair, open kinetic chain (OKC) knee extension in sitting
 should be avoided in the maximum protection phase due to semimembranosis and popliteus
 attachments to medial and lateral menisci respectively.
- Core stability exercises are an essential part of human movement. Isometric, concentric and eccentric contraction of the musculature around the abdomen, pelvis and hip joint are introduced via functional exercises. These exercises will have an overflow effect onto distal joint segments such as the knee joint. Balance and proprioceptive elements can also be incorporated into these exercise drills. This increase in workload is assisted with the use of various pieces of inexpensive and simple equipment, such as a Swiss Ball, medicine ball, rocker board and bungee cords of various resistances.
- Close Kinetic Chain Exercises such as pain free leg press and step up exercises can be introduced in the maximum/moderate protection phase of the rehabilitation schedule. These more functional weight-bearing exercises provide stimulus to quadriceps, hamstring and calf muscles, concentrically and eccentrically, as well as providing a proprioceptive stimulus.

Once these goals have been achieved by the patient, the rehabilitation programme develops into more functional-moderate protection based work with increased weight bearing activity. This creates compressive forces across the knee, which in turn decreases the shear forces across the joint and the ACLR. Close kinetic chain exercise loads and proprioceptive based activity prepare the joint before entering the minimum protection phase at approximately 12 weeks. These time scales are very loose fitting in the patient's prospective progress. Constant re-assessment and appropriate goal setting adjustments ensures the rehabilitation schedule is more of an outline than a predetermined time scale 'recipe'

Proprioceptive Exercises

Impaired joint 'position' sense – proprioception -occurs in any type of joint injury. ACL injury and subsequent surgery will therefore have a derogatory effect on the afferent/efferent stimulus/response cycle, so re-training and rehabilitation of the neuromuscular system is a vital component of the post-operative schedule. Most of the research in relation to proprioception at the knee joint has been performed in connection with ACL injury, yet many of the conclusions also have bearing on many other injuries that occur in the knee. For example, quadriceps contraction, a vital part of any knee rehabilitation programme and which is driven by afferent information, has been shown to reduce the strain produced in the medial compartment of the knee joint when a valgus force is applied (White & Raphael, 1972)

Green text – Maximum Protection Phase

Orange Text – Moderate Protection Phase

REHABILITATION PROCEDURE FOLLOWING ANTERIOR CRUCIATE LIGAMENT

RECONSTRUCTION OF THE KNEE

Time Scale	Activity Level
Immediate Post-op	-Continuous Passive Motion (0-60 degrees) increase 10 degrees per day to 90 degrees maximum.
	-Ice and Elevation (Avoid moisture on wound) Cryocuff
	-Thackeray splint/or limiting brace
	-Weight-bearing with crutches as tolerated
	-Ankle mobilising exercises
	-Patella mobilisations
	-Static quadriceps/ Trophic stimulator if inhibited due to pain,3-6 hours per day for slow oxidative fibres
Week 1-6	-Supervised knee mobilisation work, flexion and full extension
	-CPM 0-90 degrees
	-Prone lying, knee extended over bed (30 minutes per day)
	-Weight bearing as tolerated with crutches
	-Multi angle, submaximal isometrics (Quads/Hamstrings)
	-Straight leg raises (4 planes)
	-Mini squats (30 degrees of lumbar flexion)

Time Scale	Activity Level
	-Hamstring curls
	-Patella mobilisation
	-Calf raises
	-Pelvic and lower limb extensor thrust work, to simulate the mechanics of running
	-Hamstring/Calf flexibility work
	-Early balance, weight transference and proprioceptive work
	-Cliniband CKC order -Front Pull (137% H/Q); Cross Over (115%); Back
	pull (70%); Reverse Crossover (60%) (Schulthies et al,1998)
	-Swelling control using ice and electrotherapy modalities
	-Wound care
Week4	-Bicycle for ROM and compression stimulus
	-Pool walking programme (if wound completely healed)
	-Submaximal quads eccentrics (40-90 degrees)
	-Hip extension/flexion (Total hip machine)
	-Leg press,0-60 degrees (Two leg)
	-Mini squats (Vertical)
Brace removed if	ROM 0-115
	Decreased effusion
	Quadriceps control of knee in lying and standing

Time Scale	Activity Level
Week 6-8	-Full weight bearing
	-Leg press (1 leg), Isokinetic if available
	-Hamstring curl (1 leg)/Hamstring re-education pattern
	-Skipping
	-Swimming programme (Crawl kick only)
	-Step ups, varying height and weight
Week 9-12	-Lateral step ups
	-Knee extension (90-40 degrees),2 leg
	-Hip abduction/adduction (Total hip machine)
	-Cycle work for aerobic exercise, using pulsemeter
	-Pool running
	-Step Machine
Week 12	-Isokinetic Test
	-Begin running programme if satisfactory clinical, functional and isokinetic test
	-Initially, increase intensity of running by time factor (15 minute plus 5
	minutes, alternate days)
	-Submaximal eccentric quadriceps work (40-90 degrees)
Week 16	-Leg press with jump (1 leg)

Time Scale	Activity Level
Week 18	-Begin functional work, skill drills and plyometric work
	-Increase intensity of running programme with cutting, backward and functional patterns.
Week 24	Isokinetic Test, full ROM,60-180-300 degrees per second
Week 28	Isokinetic Eccentrics, Sub maximal
Week 32	Isokinetic Eccentrics, maximal
Week 36	Concentric/Eccentric/Endurance/Functional Test
	RETURN TO PLAY
Week 52	Isokinetic Test, Concentric/Eccentric, Quads/Hamstrings
	BEWARE PATELLO FEMORAL/GRAFT SITE SYMPTOMS
	ADJUST PROGRAMME AS REQUIRED

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