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Management and Rehabilitation of the Injured Anterior Cruciate Ligament Mini Series

Session Three: Rehabilitation in the Minimum Protection Phase (12 weeks - Return to Play)

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As the ACLR patient moves into the final phase of rehabilitation, the minimum protection phase, several clinical goals will already have been attained from the first two phases of the rehabilitation process. Activities now become more functionally based, with various changes in the rehabilitation goals set by the therapist. Joint speed and an ability to absorb force during activity allows the patient to safely move into more occupational or sport specific activities. This functional progression restores physical and psychological confidence in the injury site progressing from static to dynamic activity. An organised progression of rehabilitation is the key to success in returning to pre-injury activities. Adaption of the rehabilitation structure and schedule is dependent on how dynamic the therapist is, yet has an ability to recognise the various pitfalls which may occur if progression is too hasty.

- **Speed of Movement**

Each joint in the human skeleton has to work at a specific angular velocity in order to produce a total movement pattern. Table 1 demonstrates the different speeds required at various joints during active exercise and this demonstrates the wide spectrum of velocities required to go from walking to specific high speed activity.

JOINT	ACTIVITY	VELOCITY	REFERENCE
Sub Talar Jt	Running	540°+/- 167°/sec	Smith et al (10)
Ankle	Running	160°/sec	Mann et al (11)
	X-Country Skiing Hill	268°/sec	Davies et al (12)
Knee	Walking	233°/sec	Wyatt and Edwards (13)
	Running	1105°/sec	Parker (14)
	Karate	1980+/- 90°/sec	Shaw et al (15)

Table 1 Angular Velocities at various joints of the lower limb during activity

Following injury the injured athlete is often reluctant to work the injured area at the desired functional speed and this will have a derogatory effect on gait pattern. Advantages of fast/functional contractile velocity exercises include:-

1. Re-education of functional activity
2. Decrease in joint compressive forces
3. Increase in synovial fluid lubrication with nourishment of the articular cartilage
4. A physiological overflow from faster to slower speed exercise

Performing rehabilitation programmes which include fast /functional contractile velocity exercises therefore supports the principle of specific training for high performance activity.

- **Linkage System**

Single joint-muscle factors, such as strength ratios, may only be relevant in isolated cases. In the multi joint-muscle linkage system of which the knee (ACLR) is a key component, physical deficits can affect whole body performance in recreational and high performance sporting activities.

In the sporting environment a muscle, muscle group or an entire extremity needs to generate and absorb forces that may exceed its strength potential. Injury to the knee interrupts the normal transmission of these muscular and joint forces along more proximal and distal structures. When applied to physical therapy, the link system emphasises the interdependent nature of individual components and their ultimate contribution to the entire system. Recognition of this disruption to the knee, hip, pelvis, abdomen and upper limb is essential to ensure a complete rehabilitation programme.

Around the knee joint the quadriceps, hamstrings and gastrocnemius cause movement at more than one joint so require synergic contraction of stabilising muscles to isolate a single motion. For example active knee extension requires co-contraction of the hip extensors to prevent hip flexion. Without this stabilisation, the knee cannot extend with maximum strength. The type of exercises which may be reproduced can be very functional and utilise a total movement pattern.

- **Sport Specific Skill**

The therapist involved in any particular sport must be prepared to look outside the realms of the medical textbook when dealing with sports-associated injuries. Knowledge of the functional factors that are required for the role of the single competitor or team player is essential. From this, specific drills that test the physical or mental approach to the task required can be created. The player must be able to demonstrate that they can perform competently, even in pressure situations.

Different variables contribute to the intensity of the programme and the therapist needs to adjust these at the appropriate time in order to progress the rehabilitation plan from simple to complex movements. These include:-

- Size of playing area
- Number of players
- Use of equipment (number of balls, cones, manikins, tackle shields and bags)
- Intensity
- Time
- Non/full contact
- Opposed/unopposed
- Physical functional components (Jumping, falling, cutting)
- Skill functional components (Crossing, shooting, attacking, defending)

There is no hiding place for the athlete in professional sport now even when they return to competition. Many sports at the top level now use sports performance analysis systems which relay to the player, coach and support staff what actually happens in competition rather than what they perceived to happen. Research has shown that athlete and coaches can only recall 30% of performance correctly, so what about the other 70%? This information is also of use to the medical team individually in providing us with footage of the mechanics of the athlete in competition and gives game related information to make rehabilitation drills and programmes even more specific to competition.

- **Reactive Neuromuscular Training (RNT)**

Functional progression is required for a safe return to activity. By breaking the action down into a hierarchy then performing that in sequence allows for re-education and redevelopment of a specific skill. RNT drills are designed to restore functional stability about the injured joint and those specifically distal and proximal to it whilst enhancing various motor skills. The initial priority is to regain dynamic stability around the injured joint as research suggests that dynamic stabilisation produced by co-contraction is inhibited due to abnormal firing patterns of the joint mechanoreceptors following trauma.

Transitional Stabilisation Squat with lateral weight shift

Once this has been achieved active movement such as walking/running can be incorporated before progressing to more complex motor and sports specific skills. There are therefore 3 specific phases of progression with numerous interphase variables:-

1. **Static Stabilisation**
2. **Transitional Stabilisation**
3. **Dynamic Stabilisation**

Many adaptations are possible depending on the demands of the athlete and the sport. Equipment required includes cliniband/tubing, harness, single station pulley, proprioceptive aids and sport specific equipment. There is also a logical notation system for record keeping.

Summary

An organized progression of rehabilitation is the key to success in the return to sport for the injured athlete. Careful consideration of many factors some of which have been included in this discussion is essential to cover all aspects. How you adapt and utilize these factors to your specific environment is totally dependent on how 3-D you are!

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 9-14	-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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