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Rehabilitation and Functional Evaluation Following Anatomical Anterior Cruciate Ligament Reconstruction

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Introduction

The anterior cruciate ligament (ACL) injury is a highly disabling injury for the sport, once it alters the sensory data transmitted by mechanoreceptor and its consequence is instability, decrease of proprioception and postural control [1–4].

The mainstay of treatment is surgical management with the purpose of reconstructing anatomically the native ACL to better restore kinematics, this technique is known as Anatomic Reconstruction [5]. The torn ACL fibers are used with the graft to preserve the mechanoreceptors and to have better postural control [6].

Despite there being researches supporting higher functional results after this technique, there are evidence of the existence of proprioceptive, motor and postural control deficits even after the postoperatively rehabilitation [3]. For this reason, the sensory information and functional outcome after ACL reconstruction still needs to be more investigated [3].

A variety of protocols have been published in recent years. They are commonly divided into phases, and they aim to obtain full range of motion, strengthening, neuromuscular control, improve functional outcomes and provide a safe return to sport [7–10]. However, in the protocols, new criterias for lower limb function should be developed, the exercises periodization should be described, and the progression into the phases should occur after the patients can complete all the task's phases.

Besides the importance of performingthe protocol correctly, the athlete's deficits do not occur after the return to sport. It is essential to establish objective criteria in order to accurately assess an athlete's ability through the end of the stages of the rehabilitation and safe return to sport.

At the Group of Sports Medicine - Institute of Orthopedic and Traumatology of the University of São Paulo Medical School (IOT HC-FMUSP), Medical Center of excellence FIFA, the remain ACL fibers are preserved as close as possible. The postoperative rehabilitation after the anatomical reconstructions using hamstrings tendon graft follows the protocol in Table 1. It is a patient tailored rehabilitation as Zafagnini et al [11] described. The program is divided into 5 phases: Immediate, early, intermediate, late and return to competition, with specific determinant goals for phase progression. At this type of progression criteria, patients are prepared to progress to next stage if they have ability to perform all the phase's task. Emphasis is put on early range of motion, preservation of quadriceps function, progression of activities and not exceeding the limits of the involved tissue healing properties

When combined injuries occur, during the preoperative stage, modifications to the rehabilitation process are warranted. If a meniscal repair is performed concurrently with ACL reconstruction, the modifications include restricted weight-bearing and knee flexion is limited to less than 90° for 4 weeks. For meniscectomy the protocol is not changed.

Usually, microfracture with ACL reconstruction is followed with no weight-bearing. However, in cases when the cartilage lesion is on non-contact area in full extension, the weight bearing is restricted and progresses gradually, until no restriction, during 8 weeks.

Currently, the measurement of muscle strength, stability, neuromuscular function and control is recommended. However, there's a lack of objective assessment in the published literature, regarding the release for unrestricted activities [12].

Unlike other protocols, in our group, the athletes following the ACL reconstruction have been evaluated not only by the Hop Test, isokinetic dynamometry, questionnaires such as IKDC and Lysholm, but also by posturography. Besides, the latter has been applied but it is not the routine for all patients. The posturography evaluation is carried out by four tests in single leg stance: eyes open, eyes closed, the squat (0º-45º) and the kick movements. However, the squat and kick movements are not validated .The last test is done from the internal rotation of the trunk on the support limb and hip simulating a kick with the lateral border of the foot. The movements are continuously repeated during each test and the speed of movement occurs according to the strategy adopted for each subject.

Each test is done three times on one leg support. The eyes opened the eyes closed conditions last 30 seconds, and the tests others tests last 10 seconds each.The variables obtained are sagittal and frontal plane, velocity, Area 95 (95% of the ellipse given by the trajectory of the Center of pressure area) of displacement.

The single-leg hop test is performed hopping forward as far as possible with hands behind the back, landing on the same leg.Three trials are performed and the distance of jump.

Quadriceps and hamstring isokinetic strength is assessed at velocities of 60º/s and 240º/s with the dynamometer before, 6 and 12 months after ACL reconstruction. The limitation of this protocol is that two postural control tests have yet to be validated.

Final Considerations

Although the ACL injury is widely studied, future researches

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Phase	Goals	Activities
Immediate postoperative (1 week)	Attain full extension; Range of motion 0º-90º; Gait with crutches and non weight- bearing; Quadriceps strengthening 0º	Patellar mobilization; Isometric quadríceps exercise
Early postoperative (2 week)	Walking with crutches; Range of motion 0°- 120°; Open kinetic chain 45°-70°; Strengthening	Patellar mobilization ; Co-contraction of quadriceps/ hamstrings 30°; Straight leg raise exercise in four planes; Hip strengthening exercises
Intermediate postoperative	Full extension; Full weight bearing; Normal gait pattern; Open kinetic chain 45°-90°; Increase strength; Weight bearing activities; Balance and neuromuscular re-education exercises	Co-contraction of quadriceps/hamstrings 30º; Core and hip strengthening exercises training; Step exercise; Stair climbing; Core strength training Bicycle Lateral/Forward step-ups/downs; Lateral Lunges; Gastroc/soleus stretching; Hamstring stretching;
Late postoperative	Full motion and symmetrical strength in both knees; Open kinetic chain (0°-90°); Increase strength and endurance; Increase neuromuscular control	Wall squats 0° to 70°; Body-weight squat 45°-90°; Lateral/Forward step-ups/downs; Lateral Lunges; Increase jogging/running program; Zig-zag running; Sport-specific exercises;
Return to competition	Symmetrical limbs; Normal knees; Full competition	Functional progression; Return to competition; Running; Plyometric exercises;

Table 1: ACL Rehabilitation protocol of Sports Medicine of IOTHC/FMUSP.

with different techniques of quantitative assessments are still needed as well as exercise progression criteria. They might also influence the return to sports and may be taken into consideration, both during the rehabilitation and at evaluation of the treatment.

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