POSTOPERATIVE REHABILITATION OF THE ANTERIOR AND POSTERIOR CRUCIATE LIGAMENTS – CASE STUDY

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ABSTRACT

Knee ligament injuries are among the most common sports lesions. However, injuries associated with the cruciate ligaments are rare, and normally occur as a result of high impact traumas. In these cases, surgical intervention is necessary, due to the high level of functional instability. Purpose: to develop and apply a postoperative rehabilitation protocol for reconstruction of cruciate ligaments, and to record their evolution by means of regular evaluations with validated functional questionnaires. Method: case report of a patient submitted to reconstruction of the cruciate ligaments until return to sports. The functional capacity was evaluated using knee function questionnaires (Lysholm and IKDC); range of movement (goniometer), anteroposterior displacement (arthrometer KT1000TM), strength (isokinetic dynamometer) and movement analyses (walking gait and running gait). Conclusion: the protocol was effective for improving functional stability, strength, and a safe return to sports.

Keywords: Posterior cruciate ligament. Knee injuries. Rehabilitation

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INTRODUCTION

The cruciate ligaments are interlinked and are the main rotational stabilizers of the knee.[1] The posterior cruciate ligament (PCL) is the main stabilizer against the posterior movement of the tibia on the femur and controls extension and hyperextension. Moreover, it acts as central axis of rotation of the knee. Combined ligament injuries are more easily caused with posteriorization or with varus or valgus forces applied on the hyperextended knee. The injury occurring with the knee hyperextended can be associated with injury of the posterior capsule. These lesions are usually associated with traumas of great intensity, the majority brought about by traffic accidents.[2]

In compound injuries of the knee, the guidelines of the rehabilitation program are steered by the most severe injury. If both the ACL and the PCL are injured, rehabilitation generally follows the PCL protocol.

CASE REPORT

Physically active patient (age 17, height 180 cm and weight 82 kg), player of indoor soccer and 'futsal' (indoor soccer), twice to three times a week. He was playing indoor soccer (goalkeeper) and when vying for the ball, fell with his opponent on his right knee producing a rotational movement associated with hyperextension.

The physical exam presented profuse joint effusion, limitation of range of movement, pain upon palpation and positive Lachman test. The radiographs showed focal bone lesion on the posterior edge of the distal femoral metaphysis surrounded by a thin sclerotic halo. Magnetic Resonance was performed for a better assessment, identifying signs of injury of the anterior cruciate ligament, injury of the posterior cruciate ligament, partial injury of the medial collateral ligament in its proximal third, focal point of bone edema in contusions on the posterosuperior edge of the lateral femoral condyle with minor impaction of the subchondral bone and signs of stretching of the posterior joint capsule with edema in the plane of adjacent soft parts.

After evaluation he received conservative treatment (physiotherapy) with the intention of diminishing the inflammatory process of the knee and arthroscopic surgery was performed 20 days after the injury. Reconstruction of the posterior cruciate ligament (PCL) was performed using a graft taken from the tendons of the semitendinous and gracilis muscles (St+G), and that of the anterior cruciate ligament with graft from the patellar ligament (PL). (Figure 1)

The patient underwent pre- and postoperative assessments, and subsequently periodic assessments with an interval of one month on average. Subjective and objective data were gathered during the assessments. The subjective data were acquired with the use

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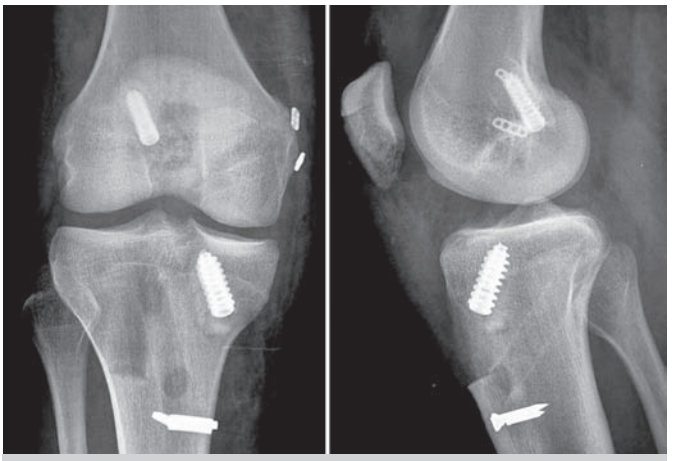

Figure 1 – *AP and lateral Radiographs in the postoperative period of the right knee.*

of questionnaires on functional capacity of the knee (Lysholm and IKDC [International Knee Documentation Committee]), while the objective data were obtained through the use of: goniometer (range of movement), tape measure (perimetry), Arthrometer KT1000-™, Isokinetic Dynamometer (REV-9000®) and Walking Gait and Running Gait analysis. The data of greatest interest were those achieved with the Arthrometer KT1000™ and Isokinetic Dynamometer, where we identified the degree of anteroposterior stability and muscular balance respectively.

Physiotherapeutic Treatment

Immediate postoperative treatment was the main phase of treatment, when there was the greatest concern in avoiding posterior translation of the tibia in relation to the femur. This period consisted of 06 weeks. In the second phase that involved the period from the 7th to the 16th week, the exercises were incremented with gradual load, aiming at the increase both of resistance and of muscular strength. In the final phase the patient was submitted to more intense activities of sensory-motor training. (Table 1)

Table 1 – *Brief report of the procedures adopted in each sector during the rehabilitation process.*

Summary of the Postoperative Treatment Phases	
Physiotherapy on Land:	
1st – 6th week	
Gain in ROM	1st week: CPM 75º - 15 min; 6th week: CPM 112º - 30 min; Gain in flexion on the edge of the stretcher (therapist's hand in the proximal region of the tibia); Gain of extension, in prone with the legs off the stretcher for 3 min.
Gain in strength	Electrical stimulation on quadriceps; strengthening with elastic resistance of hip abductors and adductors, hip extensors with knee brace, dorsi- and plantiflexion. In the 1st week with blue Theraband® evolving to gold Theraband® in the 6th week.
Gait Training	Starting from the 2nd week with use of the brace (knee in extension).
Massage	Cul de sac massage; patellar mobilization; intermittent pneumatic compression for 20 min.
Cryotherapy	Criocuff with elevation of the limb for 20 min.
7th-24th week	
Aerobic activity	Evolution: Stationary Bicycle – Elliptical – Treadmill.
Gain in strength	Mechanotherapy: bipedal leg press; unipedal leg press; calf press; extensor chair; adductor chair; flexor chair; standing flexor.
Physiotherapy in Water	
1st – 6th week	
Gain in ROM	Passive flexion
Gain in strength	Isometry of quadriceps, dorsi/plantar flexion.
Massage	Cul de sac massage; patellar mobilization.
Gait Training	anteroposterior (AP); anteroposterior and laterolateral (LL) weight transfer.
7th – 20th week	
Gain in ROM	Flexion and extension
Gain in strength and resistance	Leg press (1-3 pool noodles – 3 x 1 min); hip adduction/abduction (3 x 1min); mini squat; hopping in supine, bipedal stance evolving to jumping in supine, bipedal stance with elastic resistance; AP and LL jump; Freestyle swimming evolving to swimming with flippers.
Proprioception	Bipedal balance eyes open (one leg in front of the other); bipedal balance eyes closed (turbulence 1 min); balance board (bipedal – eyes open – 1 min); mini trampoline (trot, game with ball and header); AP and LL displacement of low intensity; displacement with header; trot with ankle float.
Sensory Motor Physiotherapy	
4th – 7th month	
Balance	Bipedal support evolving to unipedal; eyes open/closed (KT-500®; Balancer®; Balancim).
Trampoline	Transfer and AP and LL displacement; ride; *carioka (hip and pelvis)*; controlled squatting; controlled bipedal and unipedal jump; AP and LL jump.
Mattress	Trot with ballgame; four-point crossed position; up/down; controlled bipedal and unipedal jump; AP and LL jump; jumps (pliometry).
Floor	AP and LL displacement between cones; AP displacement + contact with ball + change of direction; Floor race; Races and sudden stops;
Grass	AP displacement + kick each leg + header; Training of sport gestures.

RESULTS

The patient's particulars were obtained through periodic evaluations with the use of subjective (Lysholm and IKDC) and objective (isokinetic dynamometer - REV9000®; arthrometer KT1000™; Goniometer; tape measure) assessment instruments.

Lysholm and IKDC are instruments that evaluate the functional capacity of the knee. As shown, it was observed that the patient exhibited a picture of growth during the rehabilitation process, where Lysholm (Maximum Score = 100) in the preoperative period evidenced 39 points (poor: < 64 points) and in the final phase of rehabilitation 94 points (Good: 84-94 points). The necessary points for the maximum score were related to the slight limitation on squatting. IKDC (Maximum Score) accompanied the pattern of evolution of Lysholm, starting at 36.78 points and ended at 71.26. (Figure 2)

As regards the objective data, we started with the evaluation of range of movement using a goniometer. (Figure 3)

The patient underwent two assessments using an isokinetic dynamometer (REV9000®), at the speeds of 60º/s and 180º/s, performed in the 4th and 6th postoperative month. Once again the subjective data were proven with the objective data reached with the isokinetic evaluation. There was an increase of the peak torque both for the extensor and flexor musculature during the speed of 60º/s of both legs, and a discreet deficit of the peak torque of the extensor musculature of the left lower limb (not injured) at the speed of 180º/s. (Figure 4)

The Arthrometer KT1000™ was used for evaluation of the anteroposterior laxity of the knee. Traction of 15, 20 and 30 pounds as well as maximum manual force were imposed during the assessment, and the difference between the values of the assessed limbs was below 03 mm.

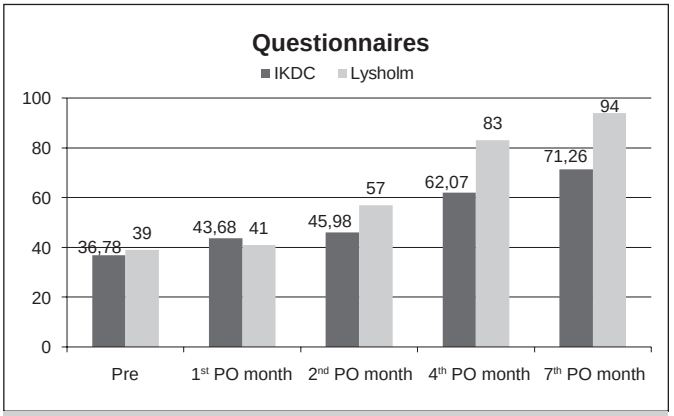

Figure 2 – *Subjective data of the assessment instruments: IKDC and Lysholm. São Paulo - 2008*

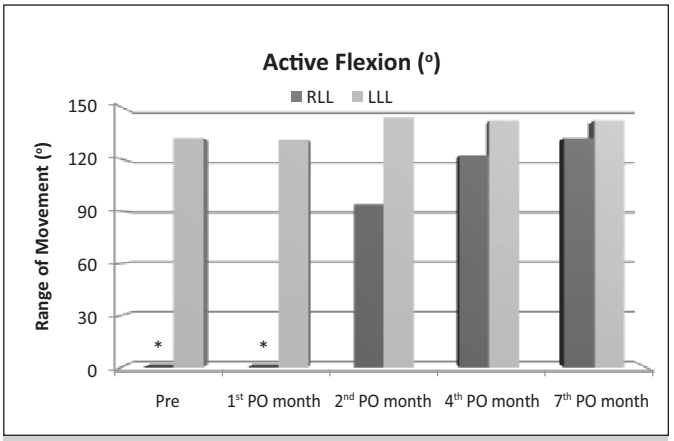

Figure 3 – *Objective data obtained with the use of a goniometer. (*) - not performed; (RLL) Right Lower Limb; (LLL) Left Lower Limb.*

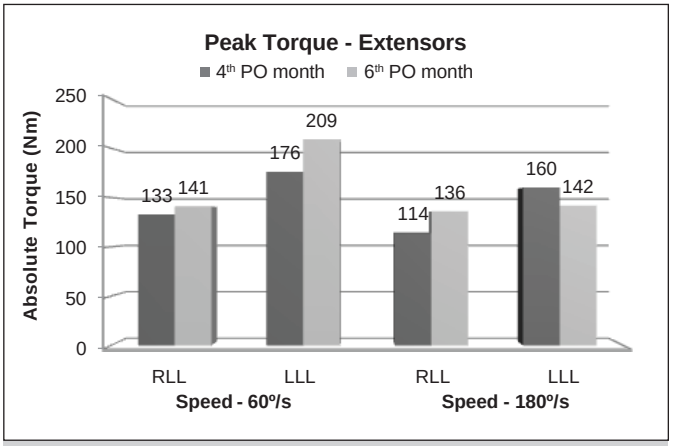

Figure 4 – *Objective data relating to the extensor muscles of the knee obtained with the use of the isokinetic dynamometer.*

The Movement Analyses (Walking Gait and Running Gait) were conducted using the Apas and Dark Fish software. During this evaluation process, the participants initially evaluated the hindfoot with the patient barefoot, followed soon afterwards by walking or running gait with the patient wearing shoes in anterior, posterior, right and left lateral view.

In the first evaluation of walking gait (2nd PO month) reduced flexion of the right knee was observed in relation to the contralateral side during load response and terminal swing, with reduced pelvic inclination during right mid stance. While in the second evaluation (4th PO month) the participants observed excessive flexion of the right thigh, in relation to the contralateral side, during terminal swing; reduction of extension of the right knee, in relation to the contralateral side, during terminal swing and reduction of pelvic inclination, during right mid stance.

Two running gait assessments were conducted (6th and 8th PO month), with identification in the first of a discrete increase in the lateral rotation of the right leg, in relation to the contralateral side, during the stance and swing phases and discrete reduction in the duration of the right stance phase, in relation to the contralateral side. No significant alterations were identified in the second assessment.

DISCUSSION

The knee is one of the joints that are most susceptible to ligament injuries, as it is located in the middle of two large lever arms (femur and tibia), and depending on the sport practiced undergoes a higher number of rotational forces. The ligaments play the role of stabilizing the knee in response to external forces. They can act separately or interacting with other ligaments and thus allow the study of the main lesion mechanisms.[1]

In the study conducted by Schulz et al.[2], they found that 143 cases from a sample group of 494 are related to combined injury of the PCL due to a traffic accident and 90/494 are related to the sports injury, with 25% caused during soccer. Majewski et al.[3] registered 17,397 patients, of which 6,434 (37%) exhibited knee injuries. Of this sample, 45.4% of the cases with injury of the ACL, and only 1.1% of the cases with combined injury of the cruciate ligaments. In view of these data we can observe how rare the case addressed in this study is.

In the trans- and postoperative phase the patient was submitted to the use of a brace locked in extension with the intention of avoiding posterior tibial translation and the weight load was directed to be performed according to the patient's tolerance, with the use of crutches and with the knee in extension.[4,5] In cases of multiple injuries the rehabilitation protocol is adopted for the most important structure. In this case the protocol of rehabilitation was established for the PCL. According to this protocol, the first six weeks are aimed at decreasing the inflammatory picture and gaining range of movement, and the procedures adopted were always designed for the protection of posterior tibial translation.[6]

No measurements were taken of the range of movement of the injured knee in the first two assessments. This is due to the fact that when performing active flexion of the knee, the individual produces a torque moment that promotes posterior tibial translation, thus increasing the tension on PCL graft.

In the arthrometric assessment (KT1000™), in the tests conducted with 15, 20, 30 pounds and maximum manual traction, the difference was lower than 03 mm of anteroposterior displacement of the tibia in relation to the femur when compared with the contralateral limb, demonstrating a good stability promoted by the neoligaments. The arthrometric assessment is an effective method

for the diagnosis of cruciate ligament rupture, particularly in the acute phase.[7,8] Hrubesch et al.[9] conducted a study evaluating functional questionnaires on the knee and concluded that the IKDC assessment form has the best correlation with the laxity measuring instruments, such as KT1000™.

In relation to the first isokinetic assessment, functional deficit of the extensor muscles of the right knee of 24% and 29% was observed at the speeds of 60°/s and 180°/s respectively for variable peak torque. This percentage is considered a slight deficit according to the population standard values referring to gender and age. In analyzing the antagonist/agonist ratio of the right knee, we encountered muscular balance, but this is due to the presence of force deficit both of the flexor and of the extensor musculature. Now the second assessment was conducted after a period of two weeks without treatment, and we believe that this fact interfered in the small increase of the peak torque of the flexor and extensor muscles.

Due to the alterations found during the walking and running gait evaluations, we developed a training program with an emphasis on the eccentric invigoration of quadriceps and gluteus medius, starting in open kinetic chain and evolving to closed kinetic chain. The eccentric strengthening of quadriceps and hamstrings should be incorporated in muscular conditioning programs to facilitate the functional activities of patients, such as sitting, slowing movement, changing direction and squatting.[10,11]

Our patient complied with the recommendations and the protocol phases, and in spite of the severity of the injury, reached an unexpected level of rehabilitation. The success of this rehabilitation process might be related to a set of factors such as: the rehabilitation phase before surgery, the success of the operation, persistence and adherence to treatment, and the assessment methods adopted to enable the rehabilitation team to achieve more credibility in decision making.

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