

## Study regarding the monitoring and optimisation in athletes' rehabilitation after cruciate ligaments injuries arthroscopically assisted

Predescu Corina<sup>1</sup>, Ionescu Anca Mirela<sup>2</sup>, Vasilescu Mirela<sup>3</sup>

<sup>1</sup> National Academy of Physical Education and Sport, Bucharest, Romania

<sup>2</sup> University of Medicine Carol Davila, Bucharest, Romania

<sup>3</sup> Physical Education and Sports Faculty, University of Craiova, Romania

**Abstract.** Six months after a meniscectomy associated with a cruciate ligament reconstruction the athlete has the force parameter regained, but the velocity and power not necessarily regained. The aim of the present study was to make a comparative analyses between results of the classical rehabilitation program for athletes and a special program to improve velocity and power based on plyometric exercises. The patients was evaluated with the universal used subjective methods (IKDC score, Lysholm scale, thigh perimeter measurement, Hop test) and using Myotest Accelerometer – rapid and very accurate test in the determination of the mechanical parameters of the performance - force, velocity and power. The combination between evaluation with subjective tests and objective measurements of force, power and velocity with the help of Myotest has proved to be a rigorous method to appreciate the athletes' rehabilitation. Having in mind that six months after a meniscectomy associated with a cruciate ligament reconstruction the athlete has the force parameter regained, but the velocity and power not necessarily regained, we have done a comparative study where the witness group (20 performance athletes) was treated with the classical rehabilitation program and the experimental group (20 performance athletes) has associated a special program to improve velocity and power based on plyometric exercises. This study underline that using a program with highlights in the rehabilitation of all three mechanical parameters of the movement (force, velocity, power), an athlete can safely return to his sports activity, with optimal values for all parameters.

**Key words:** rehabilitation, cruciate ligaments, plyometric exercises, accelerometry.

### Introduction

Rehabilitation for performance athletes with simple meniscal injuries or associated to ligaments injuries is extremely complex and needs a tight cooperation between the athlete, orthopedist, sports medicine specialist, physical therapist and trainer, every case having a suited and adapted to the injury type and kind of sport practiced rehabilitation program. To resume the sportive activity means, first of all, an extremely rigorous evaluation of the athlete in order to precisely determine his functional capacities (joint morphopathology, tendon graft state when the arthroscopic assisted meniscus intervention is combined with ligaments reconstruction), to eliminate the recurrence risk and to allow the athlete a life in competitions as long as possible. Two months after a meniscectomy or six months after a cruciate anterior ligament reconstruction the athlete returns to the sports activity and after

4-5 months or 8-9 months the athlete is able to return to contests. Regarding these aspects there are several problems: are all the mechanic parameters of the performance (force, velocity, power) regained at that time?; are there any ways to conduct the rehabilitation program in order to obtain better parameters and so the return to the sports activity to be safely done?; Which could be the most suitable evaluation methods in order to be sure about the athletes well-training?

### Material and method

We have evaluated athletes' rehabilitation after cruciate ligaments injuries arthroscopically assisted in 40 cases (20 athletes experimental group and the 20 witness athletes) with the universal used methods (IKDC score, Lysholm scale, thigh perimeter measurement, Hop test) and using Myotest Accelerometer – rapid and very accurate

test in the determination of the mechanical parameters of the performance - force, velocity and power. We used the Myotest device because we needed some methods to collect the most accurate data about the athletes' functional status before returning in competition. The measurement is done during a unipodal leap after measuring the athlete's weight and informing him about our experiment. The histograms obtained by computer analysis of the leap allowed the evaluation of the rehabilitation in the two groups.

The objectives of the physical therapy program were the specific ones for each stage: to fight against pain, to increase the tonus of the quadriceps, good posture to maintain an adequate range of motion (first stage – the first 48 hours), to increase the range of motion in flexion as well as in extension, an active stability of the knee by increasing the muscle force for quadriceps and hamstrings (second stage), return to sports activity as before the injury (third stage).

The athletes from the experimental group received and worked with the same program as the ones from the witness group, but they have begun, from the 19<sup>th</sup> day, those with simple meniscus injuries or after 18 weeks, those with ligamentoplasty, a program with plyometric exercises 2-3 times/week with a minimum of 48 hours between them. The aspect we have taken into account was the qualitative, and not the quantitative one, that is why the pass to a higher intensity type of exercises was done only after a careful evaluation of the athletes. We have chosen as part of the rehabilitation program the gradual in intensity and difficulty plyometric training because it develops the velocity, power and acceleration of a movement, helping the athlete to be more prepared to return to competitions. That way we generate a difference between that one and the athlete who did not have plyometric exercises in his rehabilitation program, but had a similar developed force. The plyometric exercises are many and diverse, for the upper as well as for the lower limb, but as in other forms of sports training, their selection must be very suited and close to the type of specific movement for the kind of sport we are dealing with. To create the rehabilitation program we have had in mind the following aspects:

There are insufficient data about the risk of injury for the tendon graft during the plyometric training. Still, because of the stress generated by the repetitive tensions of the effort in the tendon graft,

in the entire joint and especially in the connective tissue some security measurements are required: the athletes must be able to lift up a weight 1.5 higher than their own body weight using the extension of the arms and to be able to push around 1 – 1.5 of their own body weight in the bench press. The balance is also an important problem for the safety execution of the plyometric exercises. One foot standing for 30 seconds is required for a low in intensity exercise, while for more difficult exercises one foot standing with half-flexion of the knee for 30 seconds is recommended. The best surfaces for training are the ones that absorb the shock, for example the ground or special mattresses. We have chosen the mattresses because we have followed up our program in the gym.

The proper plyometric training number is, as we have written before, 2-3/week. The period of time between sessions must be around 48-72 hours in connection to the athlete state after the training and to his rehabilitation stage. The plyometric training after a day with force training is not recommended.

The efficiency of the plyometric training depends on doing every repetition with maximum effort and velocity. The rest between repetitions and series must be long enough to allow the almost complete recovery. So, 5-10 seconds between leaps and a 1:10 work-rest ratio are needed. For example, if an exercise lasts for 30 seconds, the rest between series must be around 300 seconds (5 minutes).

As in any kind of training a good warm-up is needed. Running or running on the tip-toes are recommended as part of the warm-up to prepare the muscles – the segments for the coming impact of the shock produced by the plyometric exercises. Plyometrics must be done especially in the beginning of a combined rehabilitation program, when the athlete is not yet tired.

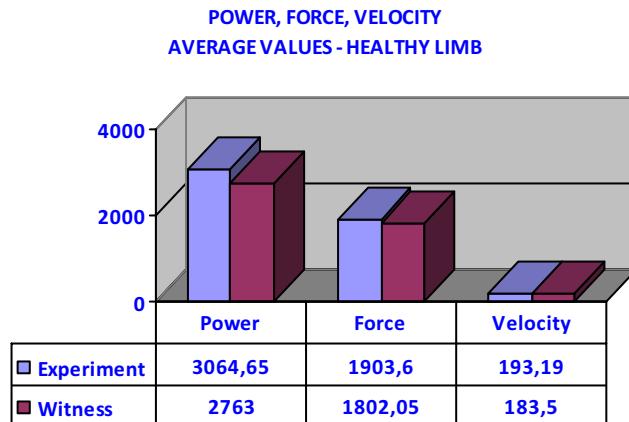
## Results

The results of our research, statistically transformed through Anova Test, indicate different values for Lysholm scale, IKDC score, simple Hop test and crossed Hop test and not significantly statistic differences between the witness group and the experimental one regarding the perimeter of the thigh. The results obtained with Myotest show that in six months after a meniscectomy with ligamentoplasty the athletes have relatively normal values regarding force, but

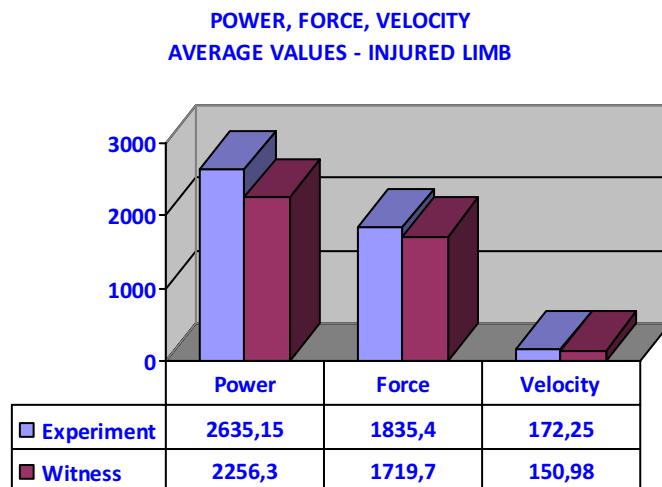
the other parameters of the performance – power and velocity – do not have symmetric values. We have initially compared the values from the healthy limb with those from the injured one in each group and then the symmetry values for the two groups.

The average values for the healthy limb and the injured one indicate higher values for the experimental group (fig. 1 and fig. 2).

**Figure 1.** The average values of power, force and velocity of healthy limb



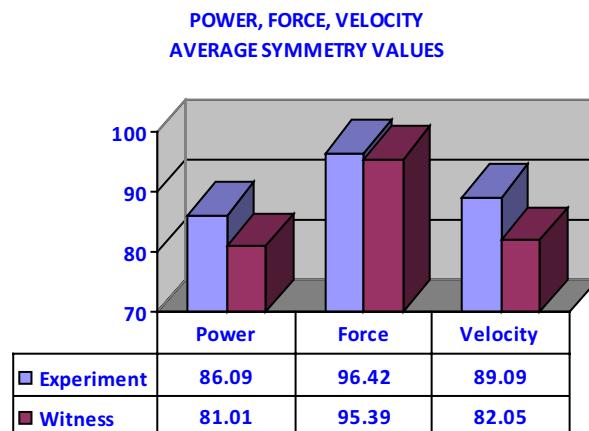
**Figure 2.** The average values of power, force and velocity of injured limb



The symmetry values show a force of 95.39% for the witness group compared to 96.42% for the experimental one. The values confirm force rehabilitation at six months after a meniscectomy with ligamentoplasty, the literature in connection mentioning 95.5 – 97%. Thus we can be sure the muscle tone is at best, the hamstrings being able now to protect the tendon graft without any risk of re-injury.

The values of the power are different between the two groups with 5.08% and the most important difference is in velocity where the experimental group with its training managed to accomplish a symmetric value for the velocity of 89.09% compared to 82.05% in the witness group. (figure 3)

Figure 3. Average symmetry values of power, force and velocity



*Force* – the very little difference between groups for that parameter – 1.03% was expected. We have to mention there are no studies with Myotest in that pathology, but the device has been comparatively tested with isokinetic device, the Bosco platform and the results are comparable.

*Velocity* – was the parameter with the highest difference of the values between the two groups, 7%. The obtained percentage is enough to sustain the necessity for that kind of training, done of course with safety measures for the athletes. The loss of type II fibers, the muscles hypotony and hypotrophy as a consequence of stopping the trainings and the fact that velocity cannot be precocious trained, the plyometric exercises, leaps and sprints that can harm the tendon graft by tensioning it, being extremely solicitant for muscles and joints explain the reason why that parameter is not trained through special exercises during common rehabilitation, when that kind of training is postponed.

*Power* – was the parameter with a variation of 5.8% between the two groups. Having in mind that in sport the capacity to produce muscle power is important for performance as well as for avoiding the possible injuries, and the capacity to fastly produce an increased muscle power is more important than to develop an increased force, we consider the power measurement necessary for trainers, physical therapists and sports medicine specialists in order to select, train and cure the performance athletes.

## Conclusions

We consider that the obtained results, the lack of possible injuries during rehabilitation avoided through a permanent follow-up of the athlete in the entire period of plyometric exercises and an adapted program for each case can be solid arguments to use that type of rehabilitation program.

The best argument though is the use of the Myotest device. Thus, the combination between evaluation with subjective tests (Lysholm scale, IKDC score) and objective measurements of force, power and velocity with the help of Myotest has proved to be a rigorous method to appreciate the athletes' rehabilitation. The fact that we can exclude the measurement of the thigh perimeter or the Hop test from the evaluation methods is in the trainer and sports medicine specialist advantage because the testing using accelerometry is more exact, offer complex data about all the mechanic parameters of the movement and the possibility to stock them allows the dynamic follow-up of the athletes and an efficient control of their rehabilitation and, why not, of the healthy athletes training. The device is very easy to be manipulated, it is portable, and the built-in goniometer allows the evaluation regarding the range of motion during the period of rehabilitation.

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*Corresponding author*

Predescu Corina  
National Academy of Physical Education and Sport,  
Bucharest, Romania  
E-mail: corina.predescu@yahoo.com

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