ISOKINETICS AND RECREATION

Nataša Desnica Bakrač[1], Mirna Andrijašević[2]
[1]Cybex Center for Isokinetic diagnostics and rehabilitation, Zagreb, Croatia
[2]Faculty of kinesiology, Zagreb, Croatia

Introduction

Numerous health problems caused by modern way of life have greatly influenced global consciousness about physical fitness. Interest in recreational and sports activities for the general public has grown rapidly in the past decade. Unfortunately, attempts of such activities are often done hastily, without an adequate plan, program, or supervision, and without a proper physical preparation (of muscles, tendons, cardio-respiratory system, etc.). That often results oppositely of our intention, causing more damage than benefits to the body. Sometimes the consequences are extremely serious such as myocardial infarction or stroke, but majority of problems are connected to the musculoskeletal system. Often we find torn muscles and tendons, damaged joints and ligaments, and in the worst cases even stress-fractures of the bones. Therefore, it would be beneficial to strengthen the muscles, prepare the joints, tendons and bones, before beginning the exercise program. One of the very effective methods in that respect is isokinetic exercising, during which the muscles are strengthened actively, without straining the joints. That is very important in prevention, because it brings the antagonistic muscles in balance (Kellis and Baltzopoulos 1999), and optimally prepares the musculo-skeletal system for the planned recreation. Isokinetic exercising is particularly useful for people who already have some pathological changes, especially of their joints (trauma, degenerative diseases, etc.). At the end of isokinetic rehabilitation an individual is fully prepared to start his planned recreational activity, which will sustain the accomplished muscle strength, and develop the cardio-pulmonary system.

Materials and methods

In isokinetic exercises, as opposed to isotonic and isometric exercising, constant speed of motion is chosen (1-300°/sec – dynamic speed), while the resistance is accommodating and varies to exactly match the force applied at every point in the range of motion (Davies, 1992). It has proven to be a particularly suitable method for treatment of wide range of different knee injuries (Keays et al. 2000; Kvist et al. 2001). It is very efficient, since it is the only way to load a dynamically contracting muscle to its maximum capacity throughout the range of motion. Also, it is very saf*e*, because an individual will never meet more resistance than he/she can handle. Before starting the isokinetic rehabilitation it is necessary to undertake isokinetic diagnostic testing, for all muscle groups pertaining to the kinetic chain, which we want to treat. The testing shows us the exact muscle strength, work, range of motion, peak torque curve and other relevant parameters. Such data undergo a computer analysis which evaluates relative status of the tested individual, taking into account his age, gender, height, weight and level of sports activity. Based on such final values, a specific protocol is developed for each participant. According to this plan, extension, flexion, abduction, adduction and rotation exercises are performed daily, in duration of 30 minutes. During the exercising the protocols are constantly being modified, depending on the progress from one phase to the other, development of muscle strength, efficiency at different velocities, pain, fatigue, specific goals of rehabilitation, etc. For most injuries and muscle strength disbalances, 15 isokinetic treatments is usually sufficient.

Results and discussion

Isokinetic muscle strengthening is potentially very useful in the field of recreation, both for injured individuals and for the healthy ones as a preparation for recreational activities. Isokinetic rehabilitation is especially indicated for people with extreme muscle atrophy, which consequently leads to the "vicious cycle" (weak muscles cannot strengthen because every exercising loads the joints, damaged joints hurt and disable further exercising and muscle strengthening). An example of a person with a long-term knee problem who fell into that category will show the benefits of isokinetic diagnostics and rehabilitation in terms of

quantitative and qualitative positive changes in his condition. A 12-year-old patient was diagnosed with right knee instability, and was suffering from it for 3 years, accompanied with great pain. During that time he was treated with immobilization on several occasions, and has received classical physical therapy (mostly kinesitherapy), without much success. His right knee was so painful, and his muscles so week that he could only walk with the crutches for the last few months. At the age of 15, on the first diagnostic test performed on the isokinetic device, his muscle strength was extremely low (Figure1). He underwent 17 treatments of isokinetic rehabilitation, which has enabled him to actively improve the strength of his muscles, without straining his knees. Two of his isokinetic diagnostic tests taken prior to and after rehabilitation are shown in Figure 1 and Table 1. In Table 1, Test1 refers to testing before the isokinetic rehabilitation and Test2 was taken after the rehabilitation was completed. The upper row of Figure 1 shows the difference in peak torque in Tests1 (dotted line) and Test2 (full line), for the right, injured leg (extension and flexion, respectively). In the lower row the same parameters were measured for healthy (left) leg. At the end of rehabilitation, the final diagnostic testing was performed, which included the same parameters as the initial one. When we look at the low speed (60 deg/sec) test results (Table 1), the improvement in peak torque for injured leg was 477% in extension and 144% for flexion.

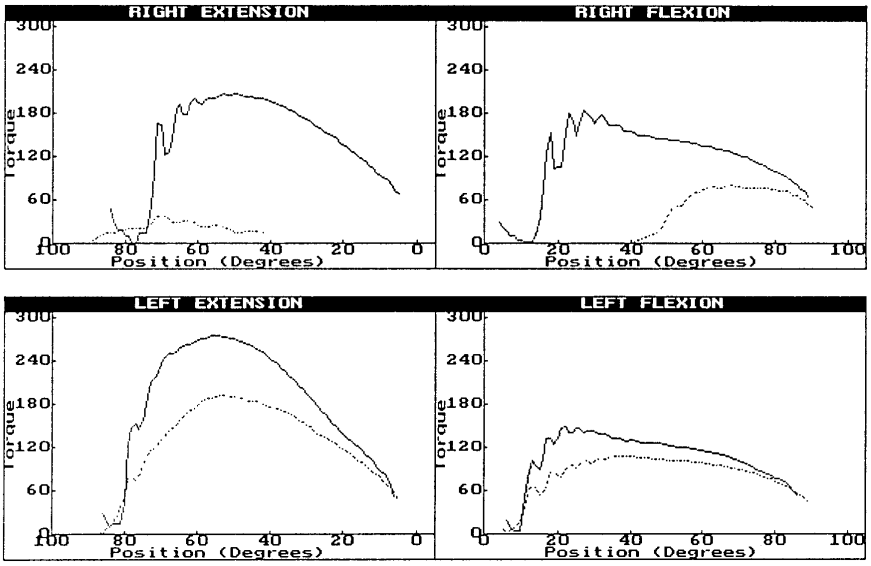

Figure 1. Knee extension/flexion isokinetic test results. Torque (Newton-Meters) is given as a function of the range of motion (Degrees). Dotted lines refer to Test1, performed at the beginning of isokinetic rehabilitation and full lines refer to Test2, performed after the rehabilitation was completed.

	EXTENSION			FLEXION		
	Test1	Test2	Change	Test1	Test2	Change
LOW SPEED TEST RESULTS						
Peak Torque (Newton-Meters)						
Right:	35	202	477 %	75	183	144 %
Left:	198	268	35 %	100	148	48 %
Work Per Repetition (Joules)						
Right:	18	194	978 %	46	152	230 %
Left:	188	251	34 %	113	141	25 %
Range of Motion (degrees)						
Right:	42	8	-34 °	91	88	-3 °
Left:	5	11	6 °	89	86	-3 °
HIGH SPEED TEST RESULTS						
Initial Peak Torque (Newton-Meters)						
Right:	0	137	0 %	0	137	0 %
Left:	125	172	38 %	87	103	18 %
Fatigue Index						
Right:	0	31	0 #	0	20	0 #
Left:	9	31	22 #	11	11	0 #
Total Work Done (Joules)						
Right:	0	1058	0 %	0	1056	0 %
Left:	1463	1793	23 %	948	1094	15 %

Table 1. Numerical values of the isokinetic diagnostic testing. Knee extension/flexion measured at low and high speed for the involved (right) and uninvolved (left) leg

Healthy leg was exercised only during the rest periods for impaired leg, and still improved 35 % in extension and 48% in flexion. In the high speed (180deg/sec) testing (Table 1), during Test1 injured (right) leg was not able to perform a given task since it couldn't have achieved a speed of 180 deg/sec. It is often the case that in the early stages of rehabilitation athletes are not able to exert tension at fast speeds (Charteris 1999).

After the rehabilitation (Test2), the peak torque of the injured leg surpassed the starting value of the healthy leg (137 Nm compared to the 125 Nm). Furthermore, the work per repetition and fatigue index have greatly improved in Test 2, so that in low speed testing work per repetition has improved form 18 to 194 Joules. Consequently, after the rehabilitation which has dramatically improved his muscle strength, his knees were stable, and he was completely pain-free. Afterwards he has continued muscle strengthening using standard weightlifting program in the fitness center, and was able to continue rowing recreatively. A year after the rehabilitation, another isokinetic diagnostic testing was performed, which has shown excellent results, with further muscle strength improvement.

Second aspect of isokinetics relevant in the area of recreation is its use as a diagnostic tool since it gives us a reliable current status of the movement system for each tested individual. Furthermore, it helps us in acquiring a better global view of the problems in the locomotor system of the general population. This can be seen in the study of the group of individuals that have been suffering from lower back pain symptoms. Isokinetic diagnostics testing has shown us the exact location of problems (weak muscle groups), and has given us guidelines for further recreational activities. This group consisted of 32 patients (11 males, 21 females), in the ages between 20 and 60 years (working population). The results obtained have shown that the knee extensors and flexors were reasonably well balanced. However, the great imbalance was found on the antagonistic muscles of the hip, where the mean values of muscle strength have been 72 % for hip extensors and 50 % for hip flexors (Figure 2). Mean percentage for trunk extensors was 71% and for trunk flexors 82%.

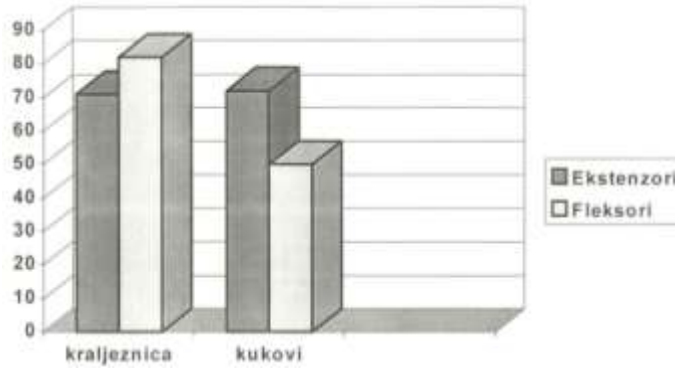

Figure 2. Mean percentages of muscle strength of extensors and flexors of trunk and hips for the group of individuals with lower back pain symptoms

These results suggest that the main problem in patients with lower back pain syndrome is not mainly in the weakness of trunk extensors and flexors, as commonly believed, but in the great imbalance found between flexors and extensors of the hip. Consequently, it is very important to start muscle strengthening of the hips, and when this strength and balance is satisfactory, add exercises for the trunk extensors and flexors. This is also very important in prevention, suggesting that to avoid lower back problems exactly these antagonistic muscles should be tested and rehabilitated if necessary. Therefore, these findings could be extremely important in planning recreational programs.

Conclusion

Isokinetic exercising has proved to be very helpful in the field of recreation. In participants with different injuries and malfunctions of the movement system it is necessary to treat that before planning any recreational activities. Also it is very advisable to use such exact muscle strengthening in individuals that apparently don't have any problems, but want to enroll in some form of recreation. Isokinetic exercising will balance antagonistic muscle groups as well as prepare the whole musculoskeletal system, and consequently enable a person to participate in various sports and recreational activities, and to lead a healthier and happier life.

In addition, *isokinetic diagnostics* has been used to evaluate present status of the musculoskeletal system, which would then enable the person to either enter the isokinetic rehabilitation, or to participate in some other forms of physical activities with the full knowledge of the current muscle strengths. Also these tests have shown us that certain muscle disbalances could lead into serious problems (such as weak hip flexors causing low back pain syndrome) if not treated properly. This gives recreational trainers the guidelines for optimal recreational programs.

References

1. Kellis E, Baltzopoulos V, The effects of the antagonist muscle force on intersegmental loading during isokinetic efforts of the knee extensors, J Biomech 1999:32:19-25.
2. Davies GJ, A compendium of isokinetics in clinical usage and rehabilitation techniques, Onalaska:S&S Publishers, 1992.
3. Keays SL, Bullock-Saxton J, Keays AC, Strength and function before and after anterior cruciate ligament reconstruction, Clin Orthop Rel Res 2000:373:174-83.
4. Kvist J, Karlberg C, Gerdle B, Gillquist J, Anterior tibial translation during different isokinetic quadriceps torque in anterior cruciate ligament deficient and nonimpaired individuals, J Orthop Sports Phys Ther 2001:31:4-15.
5. Charteris J, Effects of velocity on upper to lower extremity muscular work and power output ratios of intercollegiate athletes, Br J Sports Med 1999: 33:250-4.