

# Isokinetic rehabilitation in treating knee injuries

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## MAIN PRINCIPLES OF THE ISOKINETICS

Methods of muscle strengthening using resistance exercises:

isometric exercises: fixed speed ( $0^\circ/\text{sec}$ ); fixed resistance

isotonic exercises: accomodating speed (about  $60^\circ/\text{sec}$ ), fixed resistance

**isokinetic** exercises: adjustable constant speed ( $1-300^\circ/\text{sec}$  – dynamic speed), accomodating resistance

## ISOKINETICS

- **constant speed** of motion is chosen on the basis of specific goals of rehabilitation, while the resistance is accomodating
- **isokinetic resistance** enables exercising in the functional speed, to develop strength and endurance of the muscles, and to train the neuromuscular system to the speeds required for the dynamical functions of the extremities
- complete **accomodation of the resistance**, througout the whole range of motion; resistance adapts precisely to the capacity of strength, the pain, and fatigue of patient
  - ⇒ it's possible to rehabilitate even the most recent injuries of joints and other locomotor structures, as well as early postoperative rehabilitation.

## PRINCIPLES OF THE METHOD

- **actuator**- hydraulic mechanism, with oil, system of ventils and speed regulator; the patient using the muscle force pushes the oil from one chamber to the other; by controlling the speed of oil movement resistance is regulated automatically
- the patient uses its muscle strength- Orthotron produces the resistance; when the force stops, there is no resistance ⇒ the patient is not in danger of further injury
  - selecting the speed ⇒ low speed - development of muscle strength
  - high speed - increase of muscle endurance
- display instruments ⇒ show the force produced, separately for both antagonistic muscle groups for each extremity
  - ⇒ positive feedback to the patient, and visual control for doctor
- resistance in both directions ⇒ develops balance of the antagonistic groups (e.g. quadriceps and hamstrings)

## **ADVANTAGES OF THE ISOKINETIC REHABILITATION**

1. efficiency- the muscle is dynamically activated to its maximal capacity, constantly, throughout the range of motion
2. muscle strengthening, without loading the joints
3. possibility of developing strength (low speed), or endurance of the muscles (high speed)
4. resistance is accommodating to the patient's strength capacity throughout the whole range of motion ⇒ rehabilitation of recent injuries, and early postoperative rehabilitation
5. resistance for each extremity separately - precise strengthening of the injured extremity solely
6. resistance in both directions of motion- establishment of balance between antagonistic muscle groups – in rehabilitation and prevention ⇒ less injuries
7. very important in preoperative preparation (especially important for athletes)
8. rehabilitation of ACL rupture, using Johnson's antishear device, which restricts anterior movements of the tibia
9. rehabilitation is extremely fast, in average 3 weeks, for most of the injuries, which enables the athletes to return to their sport activities in the fastest time possible

Isokinetic rehabilitation protects damaged joints during exercise, since the resistance adapts automatically according to the muscle strength, pain, fatigue, *etc.* Thus, even heavily injured athletes, and early postoperative patients could be treated. We have developed a procedure of thigh muscles strengthening, based on the individually designed protocols. These protocols are being adjusted throughout the treatment, taking into account the progress from one phase to the other, increase of measured muscle strength, subjective complaints, efficiencies at different speeds, and other relevant factors. Extension and flexion exercises are being performed on a daily basis.

## **ISOKINETIC REHABILITATION**

for each patient we develop specific programs

(individual protocols),

constant modification of protocols during exercising, depending on

- progress from one phase to the other,
- development of muscle strength
- efficiency in different speeds
- pain
- fatigue
- specific goals of the rehabilitation, etc

# RESULTS

44 ATHLETES (aged 16 – 35) diagnosed with:

- **chondromalacia patellae** - 16 cases --11 male, 5 female
- **ACL rupture** - non-reconstructed - 20 cases-14 male, 6 female
- **ACL rupture - reconstructed** - 8 cases- 6 male, 2 female

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underwent **isokinetic rehabilitation** on the Cybex Orthotron KT2 device

- some of these injuries were recent, some of them very old and neglected
- treatments were different - conservative, and operative
- immobilisation was applied frequently
- most of these patients already underwent physical therapy treatment using classical methods (electrical currents, kinesitherapy, ultrasound, electrostimulation, etc) without much success

the result of isokinetic rehabilitation was assessed through subjective and objective parameters

- **subjective** criterion:
  - pain
  - swelling
  - instability
  - personal feeling of muscle strength
- **objective** measurements:
  - a) progress of maximal muscle strength (peak torque) of quadriceps and hamstrings was monitored every day during the rehabilitation.
  - b) prior to and after the rehabilitation, detailed dynamic status of the upper leg muscles was taken for both injured and healthy contralateral leg. This status included peak torque, work per repetition, range of motion and fatigue index.

INCREASE IN STRENGTH

- ACL – reconstructed group

**Patient: Z.O. (age 31)**

Dg.: ACL rupture

**Sport: kickboxing**

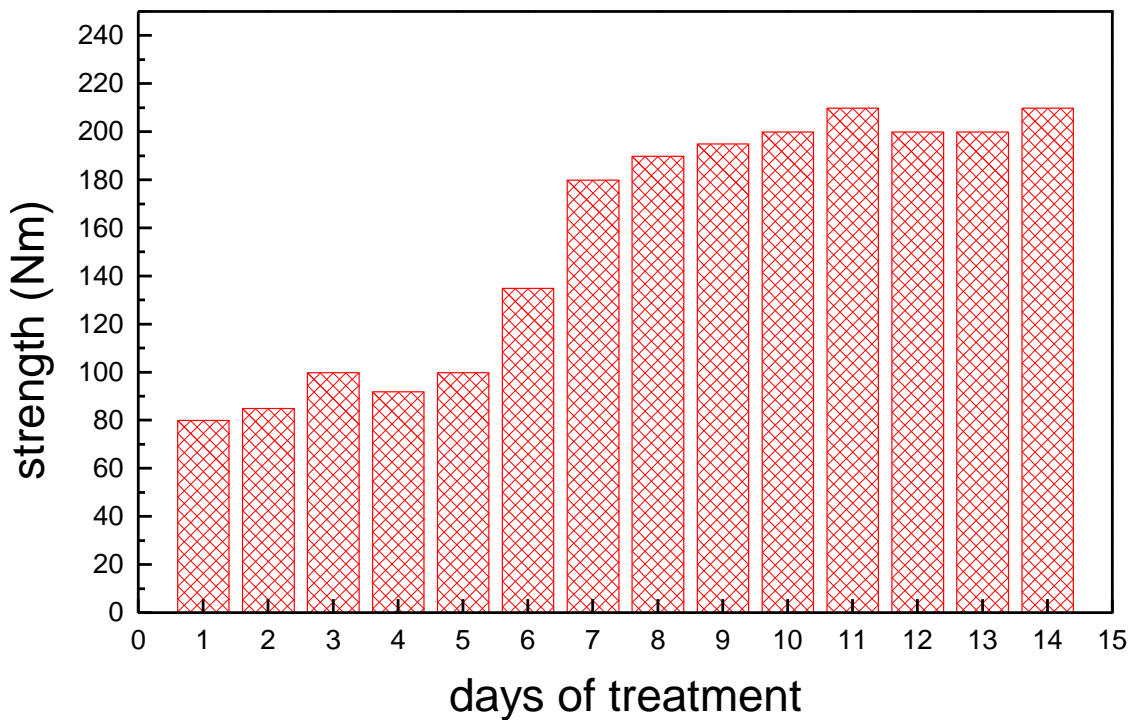
Th: surgical reconstruction  
(swing bridge method)

Rehabilitation program: Cybex isokinetics KT2

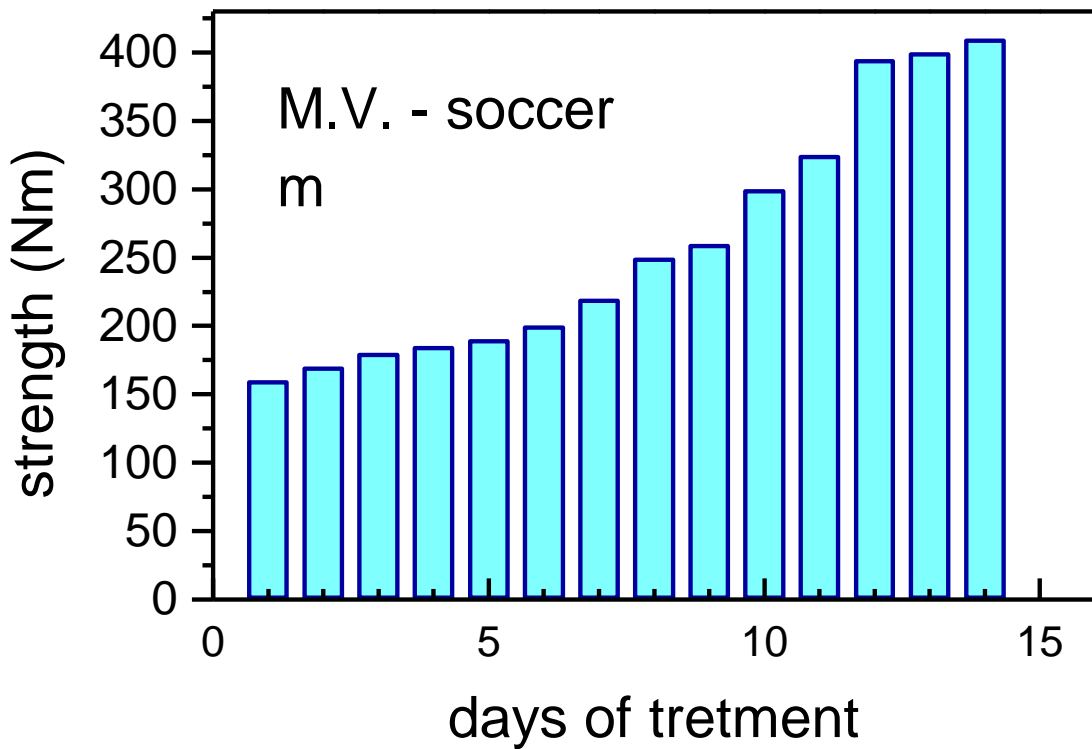
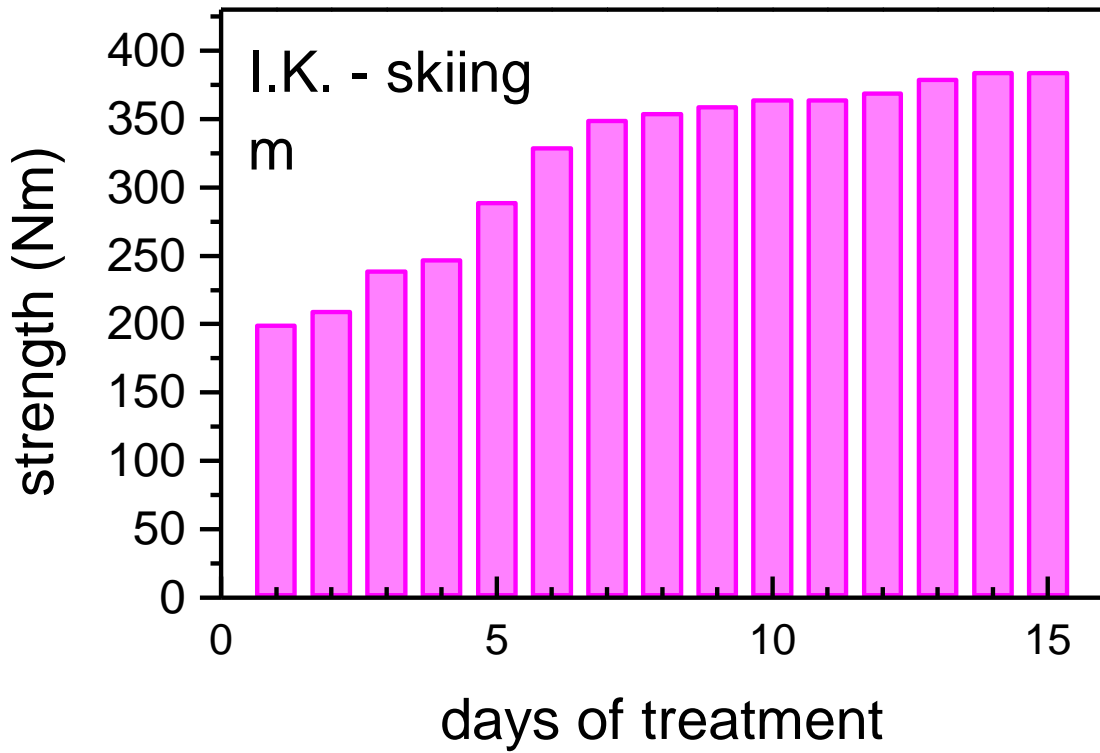
**Number of treatments: 14**

Strength at the beginning: 80 Nm

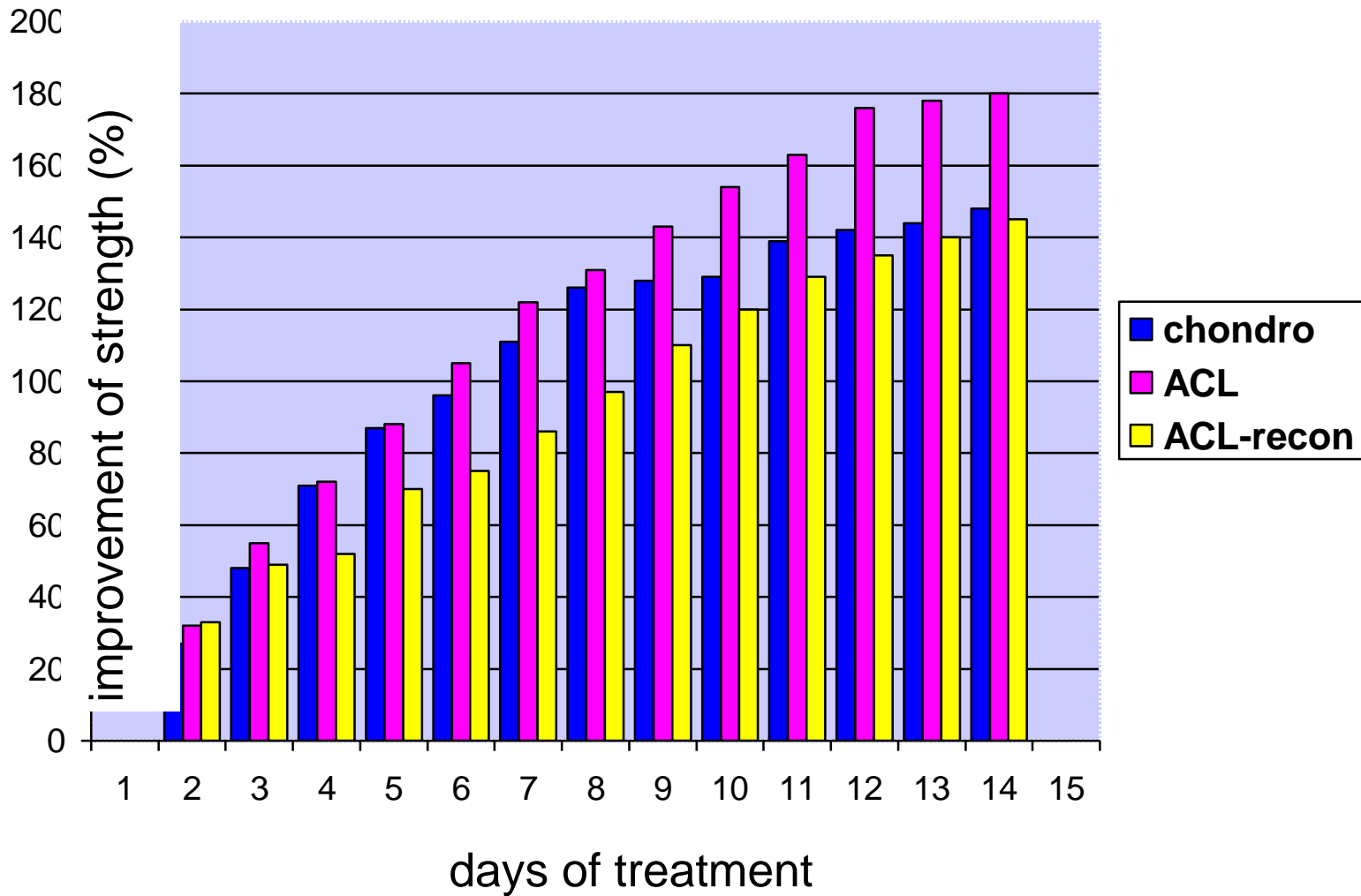
Strength at the end: 210 Nm



INCREASE IN STRENGTH  
- ACL RECONSTRUCTED group  
(selected patients)



# IMPROVEMENT OF STRENGTH – in percents (daily average of all patients in the particular group)



ACL (14M, 6 F, total 20)

ACL group	1	2	3	4	0
	BIG IMPROVEMNT IN SYMPTOMS	LITTLE IMPROVEMENT IN SYMPTOMS	NO CHANGE IN SYMPTOMS	WORSENING OF THE SYMPTOMS	NO SYMPTOMS IN THE BEGINNING
<b>PAIN</b>	no pain left 40 %	little pain left 45 %			15 %
<b>SWELLING</b>	no swelling left 15 %	little swelling left 35 %	5 %		
<b>STABILITY</b>	big improvement in stability 50%	little improvement in stability 45%	5 %		
<b>FEELING OF MUSCLE STRENGTH</b>	great increase 100%				

RECON (6M, 1 F, total 7)

RECON group	1	2	3	4	0
	BIG IMPROVEMNT IN SYMPTOMS	LITTLE IMPROVEMENT IN SYMPTOMS	NO CHANGE IN SYMPTOMS	WORSENING OF THE SYMPTOMS	NO SYMPTOMS IN THE BEGINNING
<b>PAIN</b>	no pain left 42,9 %	little pain left 28,6 %	14,3 %		14,3 %
<b>SWELLING</b>	no swelling left 42,9 %	little swelling left 42,9 %			14,3 %
<b>STABILITY</b>	<b>big improvement in stability</b> 100 %				
<b>FEELING OF MUSCLE STRENGTH</b>	great increase 100%				

CHONDRO (11M, 5 F, total 16)

<b>CHONDRO group</b>	1	2	3	4	0
	<b>BIG IMPROVEMENT IN SYMPTOMS</b>	<b>LITTLE IMPROVEMENT IN SYMPTOMS</b>	<b>NO CHANGE IN SYMPTOMS</b>	<b>WORSENING OF THE SYMPTOMS</b>	<b>NO SYMPTOMS IN THE BEGINNING</b>
<b>PAIN</b>	no pain left 81,3 %	little pain left 12,5 %	6,3 %		
<b>SWELLING</b>	no swelling left 31,3 %	little swelling left 18,8%	6,3 %		no swelling in the beginning 43,8 %
<b>STABILITY</b>					<b>stable in the beginning</b> 100%
<b>FEELING OF MUSCLE STRENGTH</b>	great increase 100%				



# INCREASE IN STRENGTH - ACL RUPTURE group

