



FUNCTIONAL RECOVERY AFTER ONE-SIDE ALL-ARTHROSCOPIC AMIC FEMORAL CONDYLE CARTILAGE REPAIR – A SOCCER CASES SERIES STUDY

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Various techniques, both palliative and reparative, have been used to treat cartilage pathology with variable success rates.

Asik et al. 2008, Benthien et al. 2010, Bentley et al. 2003, Gobbi A et al. 2005, Hangody et al. 1998, Marcacci M et al. 2002

Autologous matrix-induced chondrogenesis (AMIC) combines the microfracture method with matrix-based techniques that utilizes a collagen membrane to serve as a scaffold for new cells, allowing effective reconstruction of even large fragments of a damaged cartilage surface.

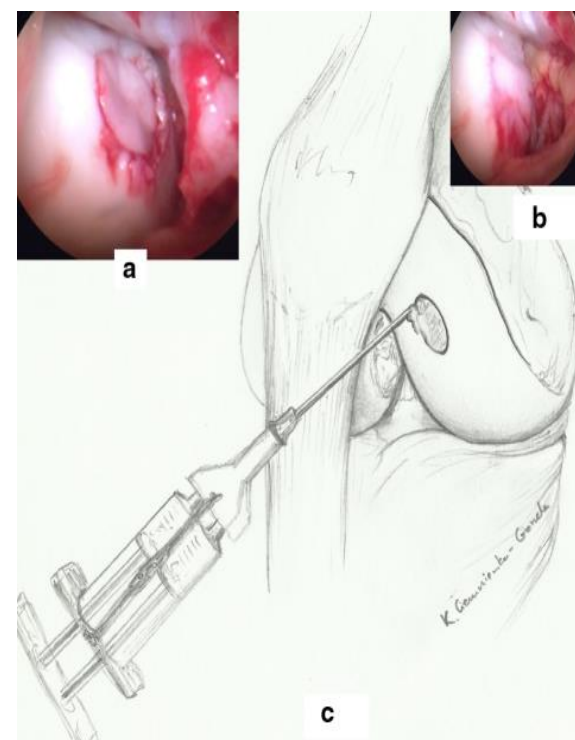
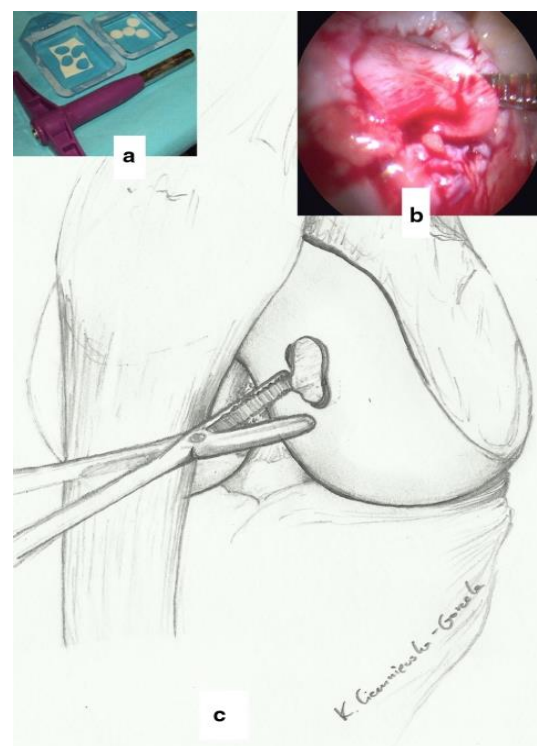
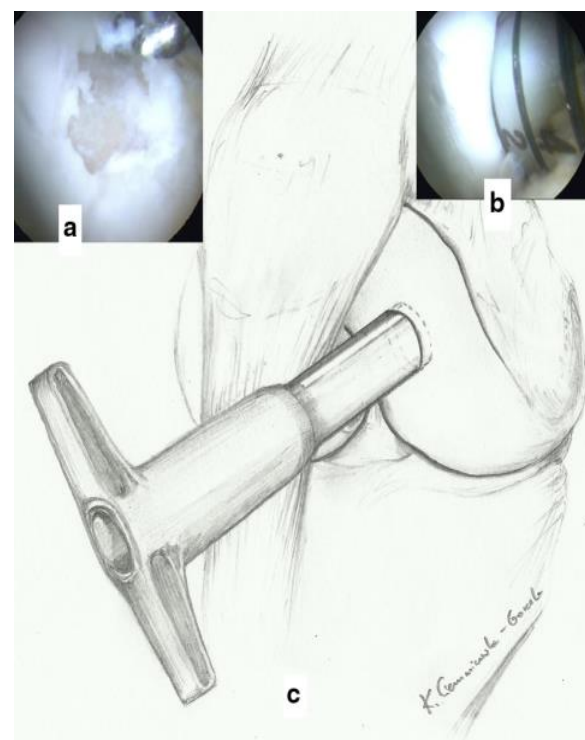
Benthien et al. 2011, Benthien et al. 2010, Girolamo et al. 2010 ; Dhollander et al. 2011

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KNEE

All-arthroscopic AMIC procedure for repair of cartilage defects of the knee

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Previous studies describe application of AMIC in cartilage damage patients in hip, knee, patellofemoral joint, distal tibia or talus.

Leunig et al. 2012, Girolamo et al. 2012, Steinwachs et al. 2008, Miska M, et al. 2012, Wiewiorski et al. 2013

Different clinical outcome scores such as: IKDC score, Tenger score, Lysholm score, ICRS score, Cincinnati score, Meyer score, KOOS score, or VAS pain score, conventional radiographs or MRI scans.

Kusano et al. 2012, Schiavone et al. 2011, Della Villa S et. al 2010, Gille et al. 2010, Kreuz et al. 2011, Dhollander et al. 2011

It is still not common to use more objective approach to analyze the therapy effectiveness in AMIC patients; even though the modern systems allows for very precious examination and were proven to be valid and reliable in functional measurements.

Toonstra et al. 2012, Durand et al. 1991

Comprehensive biomechanical evaluation is essential for the assessment of muscle strength and dynamic capabilities of the neuromuscular system in general.

Quatman et al. 2012

Objective of the study

was to evaluate the functional recovery in soccer players after one-side all-arthroscopic knee cartilage repair.

Our hypothesis

We hypothesize that there will be no differences between operated and control group in the isokinetic and postural control tests at 6 months after the arthroscopy using the AMIC technique.

Participants

AMIC group (n=6)

Aged: 28.00 ± 4.06 yrs

Weight: 78.00 ± 3.61 kg

Height: 179.00 ± 2.05 cm



Knee Surg Sports Traumatol Arthrosc. 2012 May;20(5):922-5. doi: 10.1007/s00167-011-1657-z. Epub 2011 Sep 11.
All-arthroscopic AMIC procedure for repair of cartilage defects of the knee.
Piontek T, Cierniewska-Gorzela K, Szulc A, Naczek J, Słomczykowski M.

Healthy (n=6)

Aged: 29.50 ± 2.82 yrs

Weight: 74.50 ± 2.70 kg

Height: 181.00 ± 2.60 cm



Rehabilitation

The physiotherapy protocol included 5 phases.

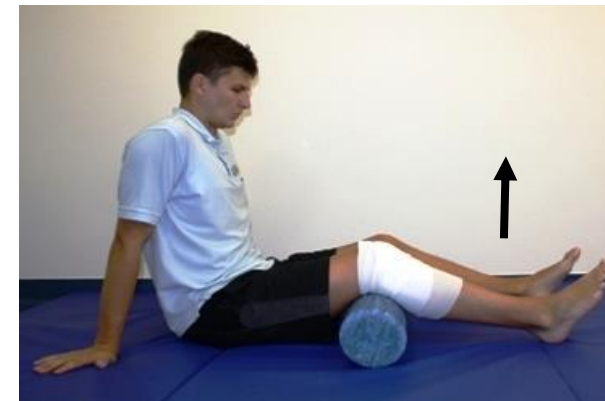
Patient was allowed to start exercises in the next stage only when particular goals were reached regarding especially functional recovery and clinical outcomes.

Usually, in our clinic, patients exercise 5 x per week, and the session lasts for 60 minutes.

Rehabilitation

The protocol included initial protection and joint activation exercises (stimulating good healing and pain and effusion reduction), followed by a progressive joint loading and functional restoration exercises (soft tissue balance restoration, knee biomechanics and muscle function rebuilding) and, finally, soccer-specific dynamic exercises (proprioception and neuromuscular control enhancement).

Rehabilitation protocol



Phase I (1-2 weeks)

- Antithrombotic exercises
- Lymphoedema prevention is also involved
- Stretching the hamstring muscles
- Strengthening exercises are based on isometric tension of the quadriceps, gluteal, adductor and abductor muscles
- Patellar mobilizations
- Passive exercises of the range of flexion of the operated limb up to 90 degrees

Rehabilitation protocol

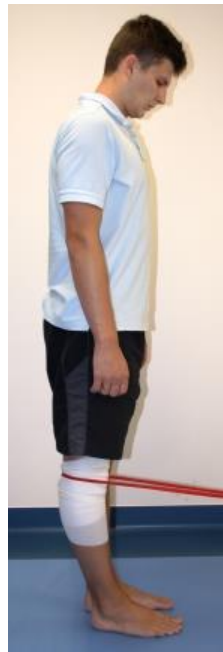


- Phase I
(1-2 weeks)
- Antithrombotic exercises
 - Lymphoedema prevention is also involved
 - Stretching the hamstring muscles

No swelling, no pain, no increased temperature of the joint, flexion range of about 90 degrees are the condition for moving to phase II.

- gluteal, adductor and abductor muscles
- Patellar mobilizations
- Passive exercises of the range of flexion of the operated limb up to 90 degrees

Rehabilitation protocol



Phase II (3-6 weeks)

- Athlete continues to perform exercises from phase I
- In addition, active exercises are performed in the horizontal position
- Active exercises of the hip joint with elastic resistance
- Gradually proprioceptive non-weight bearing exercises are introduced
- Core stability exercises
- Stationary bike with minimal load is introduced
- Exercises in water

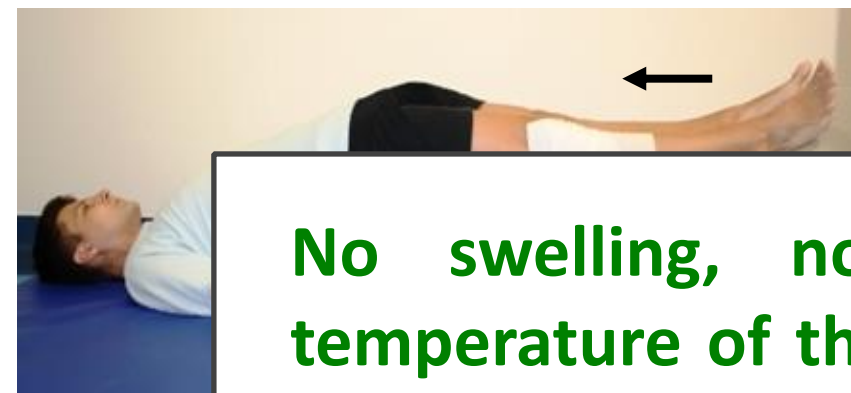
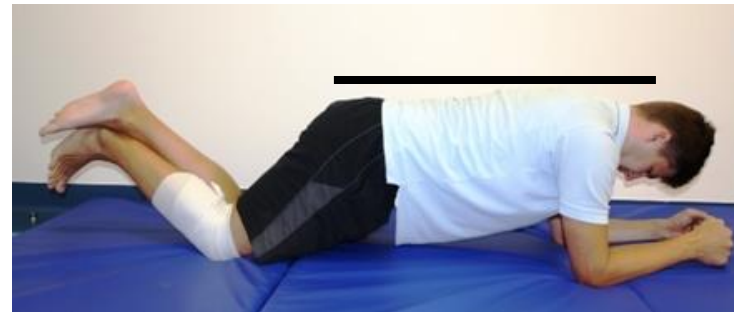
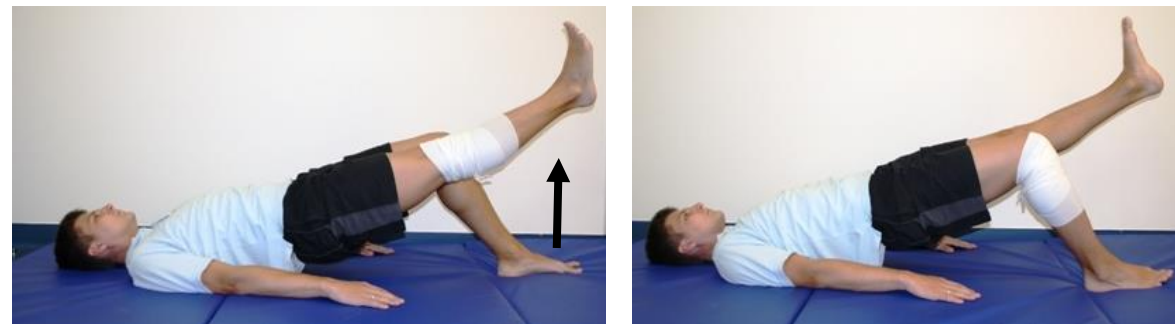
Rehabilitation protocol



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Rehabilitation protocol

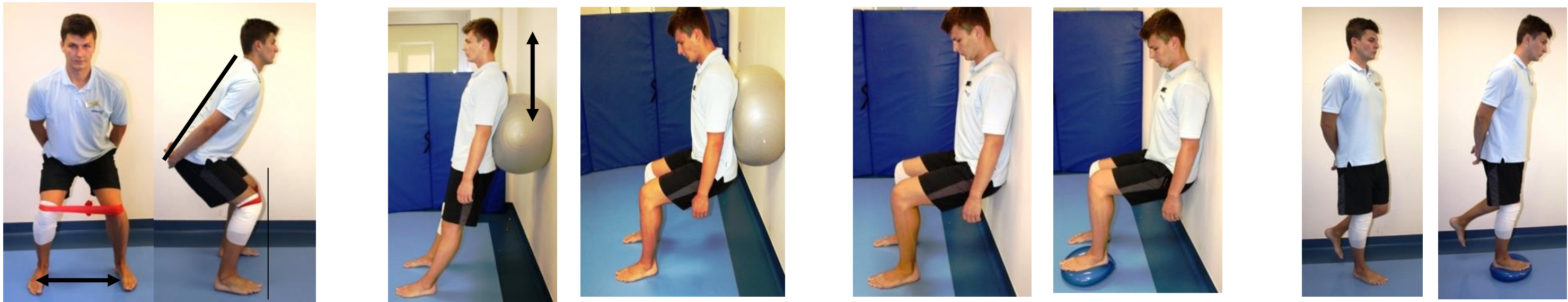


No swelling, no pain, no increased temperature of the joint, flexion range of about 120 degrees are the condition for moving to phase III.

Phase II (3-6 weeks)

- Athlete continues to perform exercises from phase I
- In addition, active exercises are performed in the horizontal position
- Active exercises of the hip joint with elastic resistance
- G bearing exercises are introduced
- Core stability exercises
- Stationary bike with minimal load is introduced
- Exercises in water

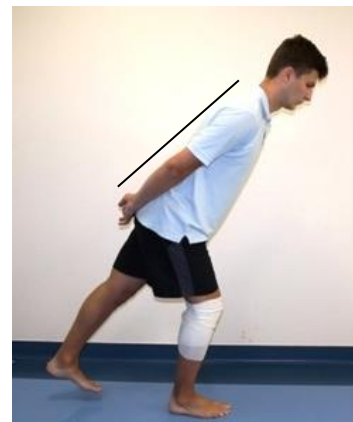
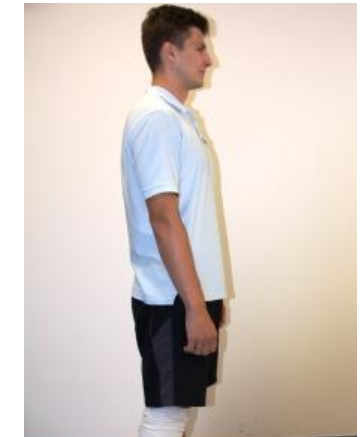
Rehabilitation protocol



Phase III (6-8 weeks)

- Athlete continues to perform exercises from phase II
- standing exercises are introduced
- two-legged squats are introduced up to 1/3 of the range of motion
- proprioceptive exercises with full load
- exercises stretching the quadriceps
- sit-ups up to 90° on the stable and unstable ground
- exercises strengthening the gluteus, quadriceps, and hamstring muscles – at full load, but static
- active exercises of the hip joint with elastic band, but whilst standing on the operated leg
- treadmill is introduced to verify the correctness of walking.
- exercises in water are continued
- active exercises of the hip joint with elastic resistance

Rehabilitation protocol

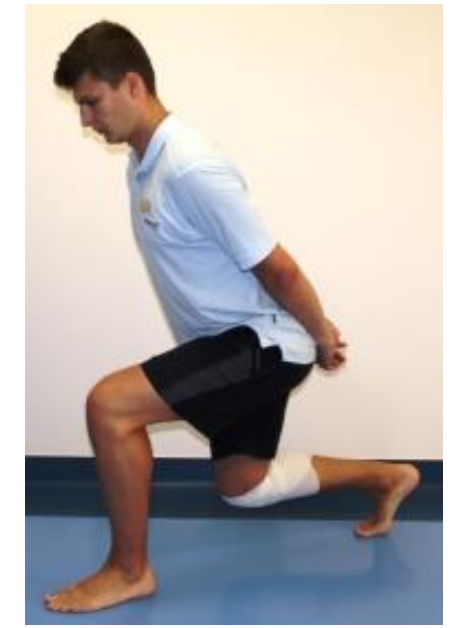
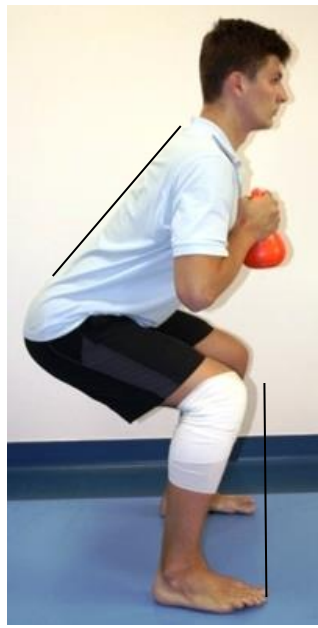


No swelling, no pain, no increased temperature of the joint, flexion range of over 120 degrees, as well as extension and proper functioning of the quadriceps are the condition for moving to phase IV and getting off crutches.

Phase III (6-8 weeks)

- Athlete continues to perform exercises from phase II
- standing exercises are introduced
- two-legged squats are introduced up to 1/3 of the range of motion
- proprioceptive exercises with full load
- exercises stretching the quadriceps
- sit-ups up to 90° on the stable and unstable ground
- exercises in water are continued
- active exercises of the hip joint with elastic resistance

Rehabilitation protocol



Phase IV (8-16 weeks)

- In phase IV the exercises performed previously are extended by adding external load, depending on the condition and capabilities of the athlete and the stage of this phase: from 5 to 20 kg.
- The warm-up on the stationary bike continues with increasing load and closed-chain exercises on stable and unstable ground
- The athlete performs also one-legged squats on stable and unstable ground, two-legged sit-ups with external load, and one-legged squats with external load. In addition, lunges are introduced together with the so-called deadlift.

Rehabilitation protocol



Phase IV (8-16 weeks)

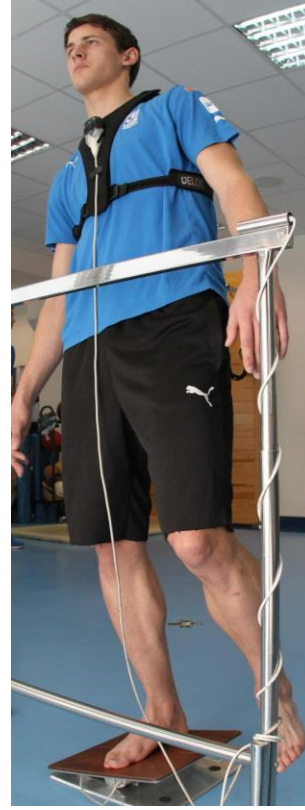
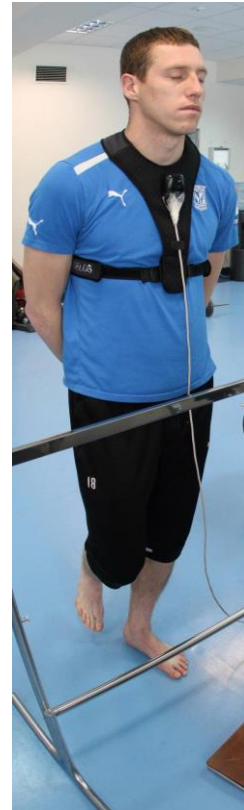
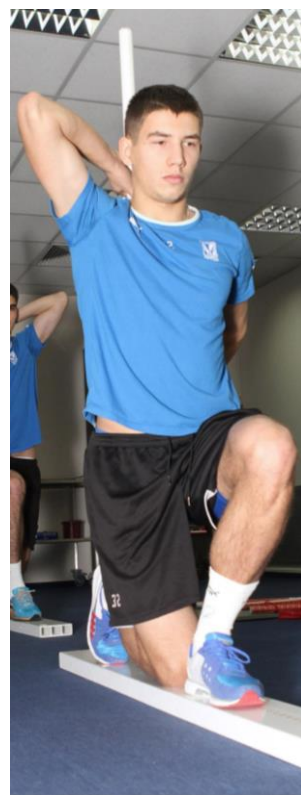
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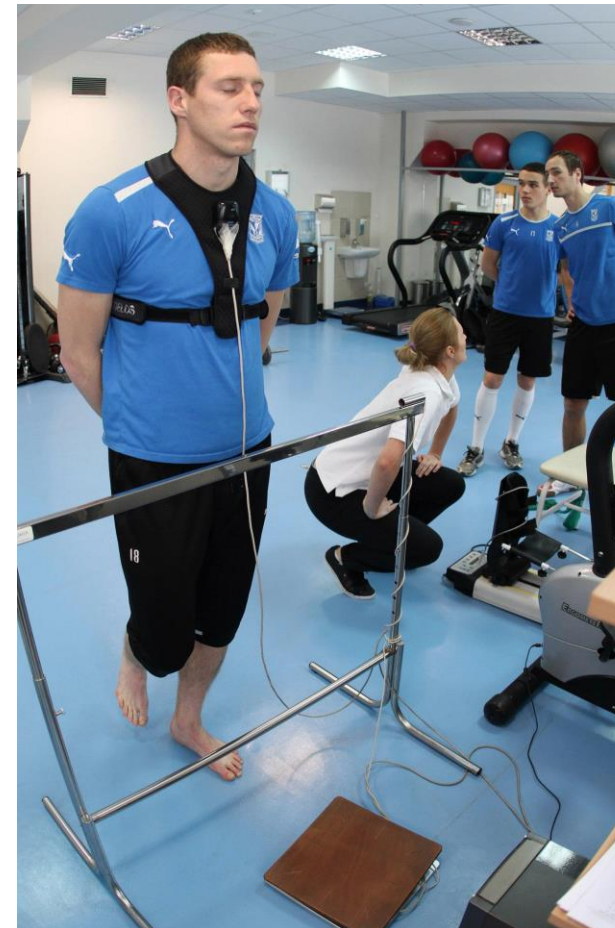
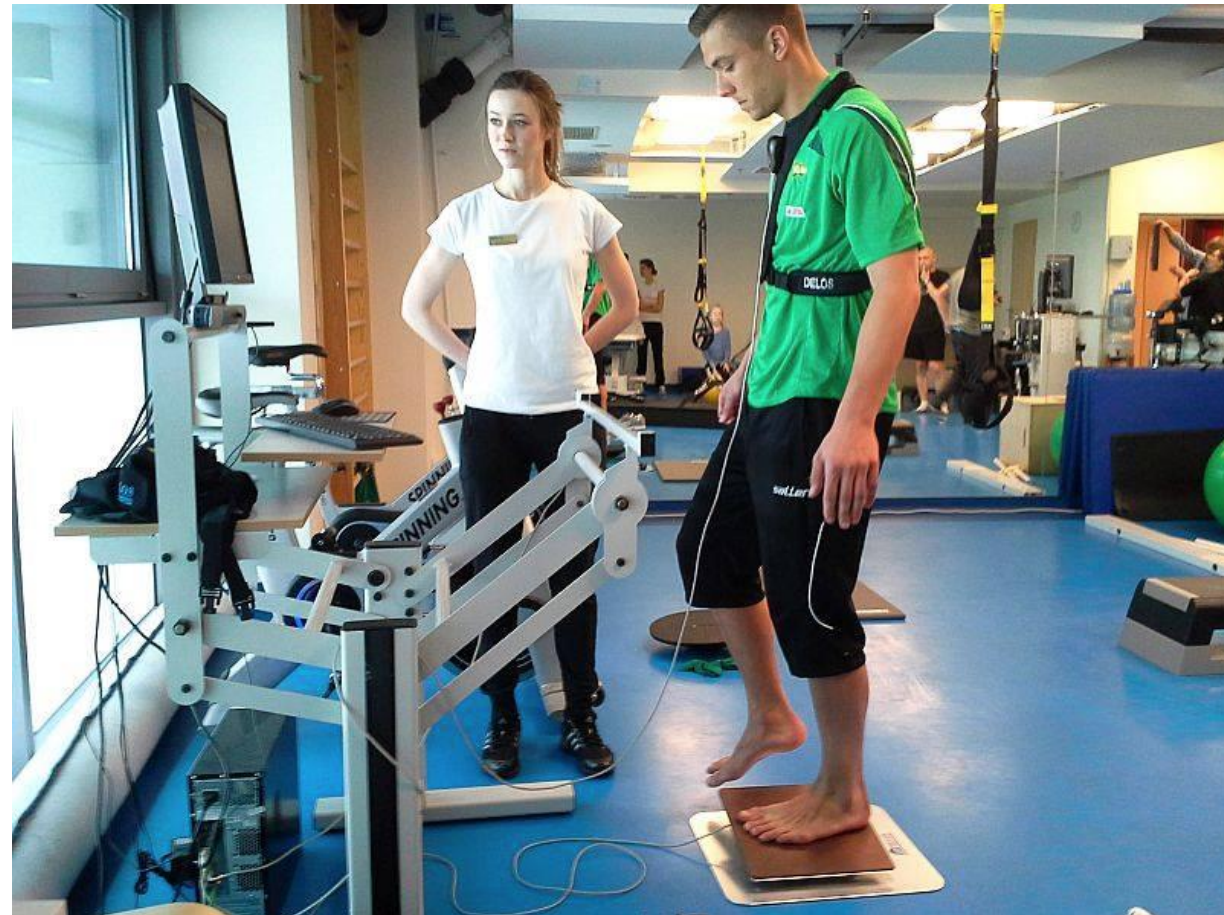
No swelling, no pain, no increased temperature of the joint, full range of motion in flexion, and proper functioning of the muscles in the operated leg are the conditions for performing a biomechanical evaluation.

Biomechanical evaluation

Proprioception, isokinetic test, ground reaction tests, FMS



Proprioception tests



time with contact [s] and postural sway [°]

postural priority [%] and time with contact [s]

Isokinetic tests



Good biomechanical results are the conditions for moving to phase V and implementing dynamic exercises

muscle strength at 60°/s and muscle endurance at 240°/s

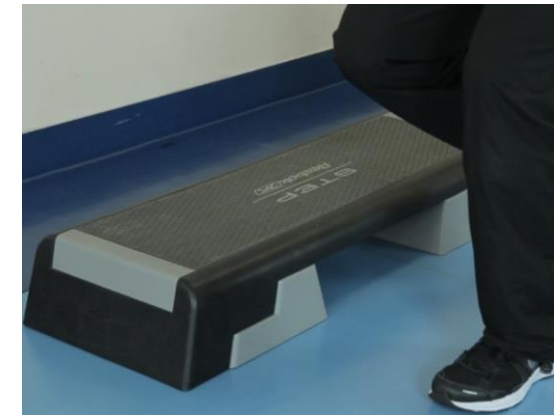
Rehabilitation protocol



Phase V (16-24... weeks)

- dynamic workout: two-legged jumps, one-legged jumps, skipping + plyometrics. Gradually, walk/run is introduced, and finally the athlete may run on the treadmill. Also, step by step exercises specific for the athlete's sport discipline are introduced.

Rehabilitation protocol



Phase V (16-24... weeks)

- dynamic workout: two-legged jumps, one-legged jumps, skipping + plyometrics. Gradually, walk/run is introduced, and finally the athlete may run on the treadmill. Also, step by step exercises specific for the athlete's sport discipline are introduced.

Rehabilitation protocol



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Statistical analysis

PQStat v.1.4.6 software was used for the statistical analysis. Descriptive analysis for all main parameters was conducted. Differences between groups in tested outcomes were analysed using the non-parametric Mann-Whitney U test. Level of significance was set at $p < 0.05$.

Table 1. Values of analysed parameters (median \pm SEM)

Feature	Limb	4 month after the surgery in the arthroscopy group	6 month after the surgery in the arthroscopy group	Compared to the matched healthy soccer palyers 6 month after the arthroscopy				
Isokinetic absolute knee extensor strength [Nm]	Operated (n=6)	103.60 \pm 18.94	p = 0.0031	217.80 \pm 13.03	p = 0.0458	Operated (n=6)	217.80 \pm 13.03	p = 0.0411
	Non - operated (n=6)	206.90 \pm 12.22		240.80 \pm 19.51		Control (n=6)	264.95 \pm 13.18	
Isokinetic relative knee extensor strength [Nm/kg]	Operated (n=6)	1.24 \pm 0.18	p = 0.0002	2.52 \pm 0.13	p = 0.0210	Operated (n=6)	2.52 \pm 0.13	p = 0.0151
	Non - operated (n=6)	3.09 \pm 0.14		3.17 \pm 0.23		Control (n=6)	3.48 \pm 0.17	
Isokinetic absolute knee extensor endurance [J]	Operated (n=6)	1452.00 \pm 232.14	p = 0.0031	3108.25 \pm 165.91	p = 0.1826	Operated (n=6)	3108.25 \pm 165.91	p = 0.0259
	Non - operated (n=6)	2984.70 \pm 138.09		3261.65 \pm 241.68		Control (n=6)	3951.30 \pm 154.26	
Isokinetic relative knee extensor endurance [J/kg]	Operated (n=6)	13.69 \pm 1.95	p = 0.0004	37.79 \pm 2.03	p = 0.1021	Operated (n=6)	37.79 \pm 2.03	p = 0.0086
	Non - operated (n=6)	31.21 \pm 1.09		44.68 \pm 2.81		Control (n=6)	51.37 \pm 2.37	

Table 1. Values of analysed parameters (median \pm SEM)

Feature	Limb	4 month after the surgery in the arthroscopy group		6 month after the surgery in the arthroscopy group		Compared to the matched healthy soccer palyers 6 month after the arthroscopy		
Time with contacts in dynamics [s]	Operated (n=6)	3.10 \pm 2.76	p = 0.6826	1.20 \pm 2.40	p = 0.7994	Operated (n=6)	1.20 \pm 2.40	p = 0.4848
	Non - operated (n=6)	3.90 \pm 2.67		0.80 \pm 1.43		Control (n=6)	0.65 \pm 0.24	
Postural priority [%]	Operated (n=6)	43.6 \pm 1.91	p = 0.9674	45.85 \pm 4.81	p = 0.8410	Operated (n=6)	45.85 \pm 4.81	p = 0.6991
	Non - operated (n=6)	45.60 \pm 2.09		49.50 \pm 2.91		Control (n=6)	45.60 \pm 6.26	
Time with contacts in statics [s]	Operated (n=6)	3.50 \pm 5.69	p = 0.8381	0.00 \pm 1.73	p = 0.9254	Operated (n=6)	0.00 \pm 1.73	p = 0.9372
	Non - operated (n=6)	4.40 \pm 6.83		0.00 \pm 0.75		Control (n=6)	0.00 \pm 0.55	
Postural sway [°]	Operated (n=6)	3.40 \pm 0.51	p = 0.4362	1.85 \pm 1.52	p = 0.8830	Operated (n=6)	1.85 \pm 1.52	p = 0.8181
	Non - operated (n=6)	3.80 \pm 1.06		2.09 \pm 1.04		Control (n=6)	2.05 \pm 0.29	

A 6-month programme of post-operative physiotherapy for soccer players after one-side all-arthroscopic AMIC femoral condyle cartilage repair procedure can provide the basis for a partial recovery and for restoring proper visuo-proprioceptive vestibulo-postural strategies of postural control.

However, based on the objective biomechanical evaluation, we concluded that the time frame was insufficient to reduce strength and endurance differences between operated and healthy professional soccer players; it seems that the rehabilitation should be extended time wise to fully restore the function of the operated limb.

The multifactorial biomechanical assessment should be used to monitor the treatment process and to choose the safest moment to return to full sport activity.



Thank you for your attention

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