

Supplementary Appendix

This appendix has been provided by the authors to give readers additional information about their work.

Supplement to: Frobell RB, Roos EM, Roos HP, Ranstam J, Lohmander LS. A randomized trial of treatment for acute anterior cruciate ligament tears. *N Engl J Med* 2010;363:331-42.

Web supplementary table A. Specific criteria for eligibility and inclusion / exclusion criteria for eligible subjects. From Frobell et al. Contemporary Clinical Trials 2007. Reproduced with kind permission of the publisher.¹¹

Eligible	<u>General criteria for eligibility</u>	
	Not eligible	
<ol style="list-style-type: none"> 1. Age 18-35 at entry 2. An activity level of 5-9 on the Tegner activity score prior to injury⁸ 3. A not more than 4 weeks old trauma to the knee 4. An ACL insufficiency as determined by clinical examination (positive pivot shift and/or positive Lachmann test). 	<ol style="list-style-type: none"> 1. Earlier major knee injury to the index knee 2. Previous knee surgery (other than diagnostic arthroscopy) to index knee 3. Associated PCL injury or MCL injury grade III in index knee 4. Concomitant severe injury to contra- lateral knee at the time of assessment 5. Injury to the lateral/posterolateral ligament complex with significantly increased laxity 6. Pregnancy 7. A history of deep vein thrombosis (DVT) or a disorder of the coagulative system 8. Claustrophobia 9. General systemic disease affecting physical function, any other condition or treatment interfering with the completion of the trial, including patients with metal devices or motion disorders 10. Systemic medication/abuse of steroids 	
<u>Inclusion / exclusion criteria for eligible subjects</u>		
Inclusion criteria	Exclusion criteria	
<ol style="list-style-type: none"> 1. A complete ACL tear as visualized on MRI. The ACL injury can be either "isolated" or combined with one or several of the following injuries visualized on MRI and/or arthroscopy: <ol style="list-style-type: none"> a. A meniscus tear that is either left untreated or treated with a partial resection b. A small, stable meniscus tear treated with fixation, but fixation not interfering with the rehabilitation protocol c. Cartilage changes verified on MRI with arthroscopically determined intact surface 2. A radiographic examination with normal joint status or combined with either one of the following findings: <ol style="list-style-type: none"> a. A small-avulsed fragment located laterally, usually described as a Segond fracture b. JSN grade 1 or osteophytes grade 1 as determined by the OARSI atlas (Altman et al. 1995) 3. Agreement to participate in the study and signed informed consent prior to inclusion. 	<ol style="list-style-type: none"> 1. One of the following associated injuries to the index knee as visualized on MRI and/or arthroscopy: <ol style="list-style-type: none"> a. An unstable longitudinal meniscus tear that requires repair and where the following postoperative treatment (i.e. bracing and limited ROM) interferes with the rehabilitation protocol b. Bi-compartmental extensive meniscus resections c. A cartilage injury representing a full thickness loss down to bone d. A total rupture of MCL/LCL as visualized on MRI 	

Pre-specified criteria for undergoing a delayed ACL reconstruction in those randomized to rehabilitation plus optional delayed ACL reconstruction

When a patient randomized to rehabilitation plus optional delayed ACL reconstruction complained about symptomatic instability of the index knee, either at a scheduled follow up visit or at an additional visit, self-reported instability was categorized by one of two well experienced clinicians (RF & HR) into:

- *ACL insufficiency induced instability* - give-way episodes (i.e. a feeling of knee dislocation).
- *Instability of other origin such as meniscus tear, loose body etc.* – pain followed by loss of quadriceps activity (i.e. reflex inhibition, jack-knifing phenomenon)

In patients wishing to undergo ACL reconstruction:

ACL insufficiency induced instability in combination with a positive pivot shift confirmed a need for delayed ACL reconstruction.

A history of instability difficult to categorize led to a second opinion from the other clinician and an additional MRI to determine the cause of instability.

Patients were informed that they had the opportunity to discontinue the study at any time. All of the above findings indicated an adverse event and was classified and reported as such. The criteria for delayed ACL reconstruction is described in web supplementary table B (below).

Web supplementary table B. This table was used to classify patients randomized to rehabilitation plus optional delayed ACL reconstruction for undergoing delayed ACL reconstruction and provides the number of patients fulfilling each criterion at 2 years.

	Remain in group	Cross over	Treatment failure	Non-complier	Drop-out
KOOS _{QOL}	0-100	≥ 45	< 44	0-100	0-100
Self-reported symptomatic instability due to ACL insufficiency (including give way episodes)	No	Yes	Yes	No	Yes / No
Pivot shift	Positive or negative	Positive	Positive	Positive or negative	Positive or negative
Patient wishing to undergo ACL reconstruction	-	Yes	Yes	Yes	Yes / No
Patient willing to stay in study	Yes	Yes	Yes	Yes	No
Number of patients at 2 years	36	5	17	1	0

Web supplementary table C. Additional baseline characteristics of study participants

	Rehabilitation plus early ACL reconstruction (n=62)	Rehabilitation plus optional delayed ACL reconstruction (n=59)	p-value
Activity at injury, n (%)			
Sports	62 (100)	57 (97)	0.14
Soccer	35	42	0.09
Alpine skiing	9	7	0.67
Floor hockey	7	2	0.10
Other	11	8	0.53
<u>MRI, n (%)</u>			
Meniscal injury, n (%)*	39 (63)	30 (51)	0.18
Uni-compartmental			
Medial	12	12	0.89
Lateral	16	8	0.09
Bi-compartmental	11	10	0.91

* Meniscal injury was classified as increased signal extending to at least one articular surface of the meniscal body.¹⁸ Knees could have more than one meniscus injury within the reported meniscus body.

Web supplementary table D. Rehabilitation and surgical treatment at baseline and during study.

	Rehabilitation plus early ACL reconstruction (n=62)	Rehabilitation plus optional delayed ACL reconstruction (n=59)	p-value
<u>Rehabilitation</u>			
Patients participating, n*	60	59	
Rehabilitation visits/patient, mean±SD	63 ± 37	53 ± 35	0.05
<u>Surgical treatment at baseline</u>			
ACL reconstruction, n (subjects)	61	-	
Hamstrings graft	36	-	
Bone-Patella Tendon-Bone graft	25	-	
Menisci with surgery, n	34	21	0.12
Partial resection (menisci), n	24	15	
Fixation (menisci), n	10	6	
Days from randomization, mean±SD	23.4 ± 9.5	23.1 ± 14.0	0.37
<u>Surgical treatment during follow up</u>			
ACL reconstruction, n (subjects)	-	23	
Hamstrings graft	-	10	
Bone-Patella Tendon-Bone graft	-	13	
Days from randomization, mean±SD	-	347 ± 124	
Menisci with surgery, n (patients)	6 (5)	29 (19)	<0.001
Partial resection (menisci), n	5	26	
Fixation (menisci), n	1	3	
Days from randomization, days ±SD	354 ± 176	304 ± 164	0.79
Other surgery, n (procedures)	13	4	0.03
Arthroscopy	10	4	
Other **	3	-	
Total number of surgical procedures requiring general anesthesia	80	61	0.19
Total number of menisci with surgery	40	50	0.20

* Defined as the number of patients having ≥10 visits at the treating physiotherapist.

** Knee mobilization under general anesthesia (n=1), removal of distal ACL reconstruction fixation (n=2).

Web supplementary table E. Specification of non-serious adverse events during the trial

		Full analysis set		p-value
		Rehabilitation plus early ACL reconstruction	Rehabilitation plus optional delayed ACL reconstruction	
		n=62	n=59	
Non-serious AE	Localization other than index knee (n)	87	103	0.13
	Ear Nose Throat	35a	36b	
	Musculoskeletal	23c	16d	
	Gastrointestinal	8e	8f	
	Urological	2g	10h	
	Skin	9i	6j	
	Eye	1k	9l	
	Gynecological	1m	4n	
	Neurological	1o	3p	
	Thorax	2q	3r	
	Other	5s	8t	
	Localization index knee (n)	87	44	<0.001
	Subjective and/or Clinical instability†	25	17	
	Pain and/or swelling	16	14	
	Decreased range of motion	12	2	
	Decreased muscle mass	6		
	Medial-lateral instability	4	1	
	Donor site problems	3	2	
	Wound problem/haematoma	3	2	
	Meniscus signs & symptoms	2	3	
	Synovitis/inflammatory reaction	3		
Other	13u	3v		
All non-serious AE (n)	174	147	0.29	

Adverse events were defined as untoward medical occurrences which did not necessarily have a causal relationship with treatment administered. Serious adverse events were those classified as having the potential to significantly compromise clinical outcome, result in significant disability/incapacity, and/or requiring inpatient or outpatient hospital care or considered to prolong hospital care, be life threatening, or result in death. This table includes all non-serious adverse events that occurred in 5% or more of the patients, or in 3% or more in any one treatment group.

- a. upper respiratory tract infection without antibiotic treatment 12, otitis media 1, bronchitis 3, asthma/allergy 6, ear wax blockage 2, tonsillitis 5, upper respiratory tract infection with antibiotic treatment 3, sinus infection 3
- b. upper respiratory tract infection without antibiotic treatment 14, otitis media 5, asthma/allergy 7, tonsillitis 4, upper respiratory tract infection with antibiotic treatment 5, sinus infection 1
- c. hand 5 (thumb pain 1, 5th finger swelling 1, finger swelling and pain following trauma 2, wrist distortion 1), contra-lateral knee 3 (undefined knee pain 1, subjective instability 1, suspected lateral meniscus lesion 1), foot/ankle 2 (tarsal tunnel syndrome 1, undefined pain and swelling ankle 1), back 2 (undefined back pain 1, upper back pain 1), lower leg 2 (swelling, pain and discoloration 1, exostosis 1), shoulder 2 (shoulder contusion 1, shoulder distorsion 1), neck 1 (neck pain), head 1 (sutured head wound), multiple joints 1 (rheumatoid arthritis), pelvis 1 (pelvic fracture), thigh 1 (suspected tendon insertion tear), ribs 1 (suspected rib fracture)
- d. back 4 (lower back pain 2, fracture of the coccyx 1, upper back pain 1), foot-ankle 3 (undefined pain 1, ankle distorsion 1, flat foot 1), groin 3 (tendon insertion tear 1, tendon insertion inflammation 2), hand 2

- (pain finger 1, mallet finger 1), abdomen 1 (pain abdominal muscle), elbow 1 (epicondylitis), neck 1 (neck pain following traffic accident), info not available 1
- e. abdominal pain 2, gastroenteritis 3, hepatitis A 1, gastritis 1, vomiting 1
 - f. obstipation 1 1, anal fissure 1, hemorrhoids 1, nausea 1, anal polyps 1, abdominal pain 1, gastritis 1, gastroenteritis 1
 - g. urology 2 (urinary tract infection 1, epididymitis 1)
 - h. urinary tract infection 2, prostatitis 1, testicular tumor 1, orchitis 1, hydrocele 1, cystitis 1, male infertility 1, genital herpes 1, visit venereology clinic 1
 - i. skin wound 2, nail fungus 1, psoriasis 2, seborrhea 1, hematoma 1, scar keloid 1, naevus control 1
 - j. pityriasis versicolor 1, skin lesions 1, foot wart 1, eczema and acne 1, oral herpes 1, nevus control 1
 - k. eye 1 (undefined eye irritation)
 - l. conjunctivitis 4, corneal erosion 1, episcleritis 1, foreign body 2, irritation 1
 - m. gynecological (candida infection)
 - n. vaginismus 1, Candida vaginal infection 3
 - o. neurology 1 (vertigo and facial sensory loss)
 - p. headache 3
 - q. thorax 2 (thoracic muscle pain 1, pain after pleuritis 1)
 - r. pain thoracic area 2, contusion thorax 1
 - s. not available 2, circulation 2 (hypertonia 1, dizziness), teeth 1 (tooth extraction)
 - t. psychiatric 2 (depression 1, crisis reaction 1), not available 2, endocrinology 2 (elevated TSH 1, flushes 1), teeth 1 (tooth extraction), general 1 (fatigue)
 - u. osteosynthesis material 2, rotational trauma 1, tumor 1, posterior thigh symptom 1, haemarthrosis 1, tendinitis 1, loss of skin sensibility 1, bone fragment 1, muscle rupture 1, clicking 1, femoropatellar symptoms 1, reflex problem 1
 - v. patellar overload 1, femoropatellar symptoms 1, contusion 1

Web supplementary table F. Baseline characteristics and surgical treatment over the 2 years for the pre-specified as-treated sub-groups: rehabilitation plus early ACL reconstruction [n=60], rehabilitation plus delayed ACL reconstruction [n=23] and rehabilitation alone [n=36].

	Rehabilitation plus early ACL reconstruction (n=60)*		Rehabilitation plus delayed ACL reconstruction (n=23)		Rehabilitation alone (n=36)	
Characteristics						
Age, mean (95% CI)	26.5	(25.1 – 27.8)	25.1	(23.2 – 27.0)	26.2	(24.5 – 27.8)
Women, n (%)	12	(20)	7	(30)	13	(36)
Body mass index, mean (95% CI)	24.4	(23.6 – 25.3)	23.3	(22.4 – 24.1)	24.2	(23.1 – 25.2)
Activity at injury						
Sports, n (%)	60	(100)	22	(96)	35	(97)
Soccer	34		16		26	
Alpine skiing	9		2		5	
Floor hockey	6		2		-	
Other	11		2		4	
KOOS, mean (95% CI) ¹						
KOOS ₄	36.9	(32.9 – 41.0)	34.6	(29.4 – 39.7)	38.2	(34.1 – 42.2)
Pain	57.0	(52.5 – 61.6)	54.1	(46.2 – 62.1)	59.4	(54.1 – 64.7)
Symptoms	48.4	(43.8 – 53.0)	45.7	(39.3 – 52.0)	48.3	(43.0 – 53.7)
Function in daily living	66.6	(62.0 – 71.3)	70.0	(62.6 – 77.3)	68.5	(62.0 – 75.0)
Function in sports and recreation	14.6	(9.1 – 20.1)	10.4	(3.1 – 17.8)	15.7	(9.9 – 21.5)
Knee related quality of life (QOL)	27.7	(23.2 – 32.3)	28.1	(21.8 – 34.3)	29.2	(24.1 – 34.2)
SF-36, mean ± SD ²						
Physical component	46.8	(42.7 – 50.9)	47.5	(43.1 – 51.8)	47.1	(43.4 – 50.9)
Mental component	67.3	(62.0 – 72.6)	64.3	(54.8 – 73.9)	66.0	(60.4 – 71.6)
Activity level, median (25th, 75th percentiles) ³						
Tegner activity score	9	(7, 9)	8	(7, 9)	9	(7, 9)
Surgical treatment at baseline						
ACL reconstruction, n (subjects)	60		-		-	
Hamstrings graft	36		-		-	
Bone-Patella Tendon-Bone graft	25		-		-	
Menisci with surgery, n	34		8		13	
Resection (number of menisci resected)	24		5		10	
Fixation (number of menisci fixated)	10		3		3	

Surgical treatment during follow up

ACL reconstruction, n (subjects)	-	23	-
Hamstrings graft	-	10	-
Bone-Patella Tendon-Bone graft	-	13	-
Menisci with surgery, n	6	19	10
Resection (number of menisci resected)	5	17	9
Fixation (number of menisci fixated)	1	2	1
Total number of surgical procedures (anesthesia), n	79	39	22
Total number of menisci with surgery, n	40	27	23

¹ Scores on the Knee injury and Osteoarthritis Outcome Score (KOOS) range from 0 to 100, with higher scores indicating better results. KOOS₄ at 2 years includes the subscales pain, symptoms, sport and recreation function, knee-related quality of life.^{19, 20}

² Scores on the SF-36 range from 0 to 100, with higher scores indicating better results.²⁴

³ The Tegner activity score assesses activity level with specific emphasis on the knee, ranging from 1 to 10 where 1 is least strenuous activity level and 10 corresponds to high knee demanding activities on a professional level.¹²

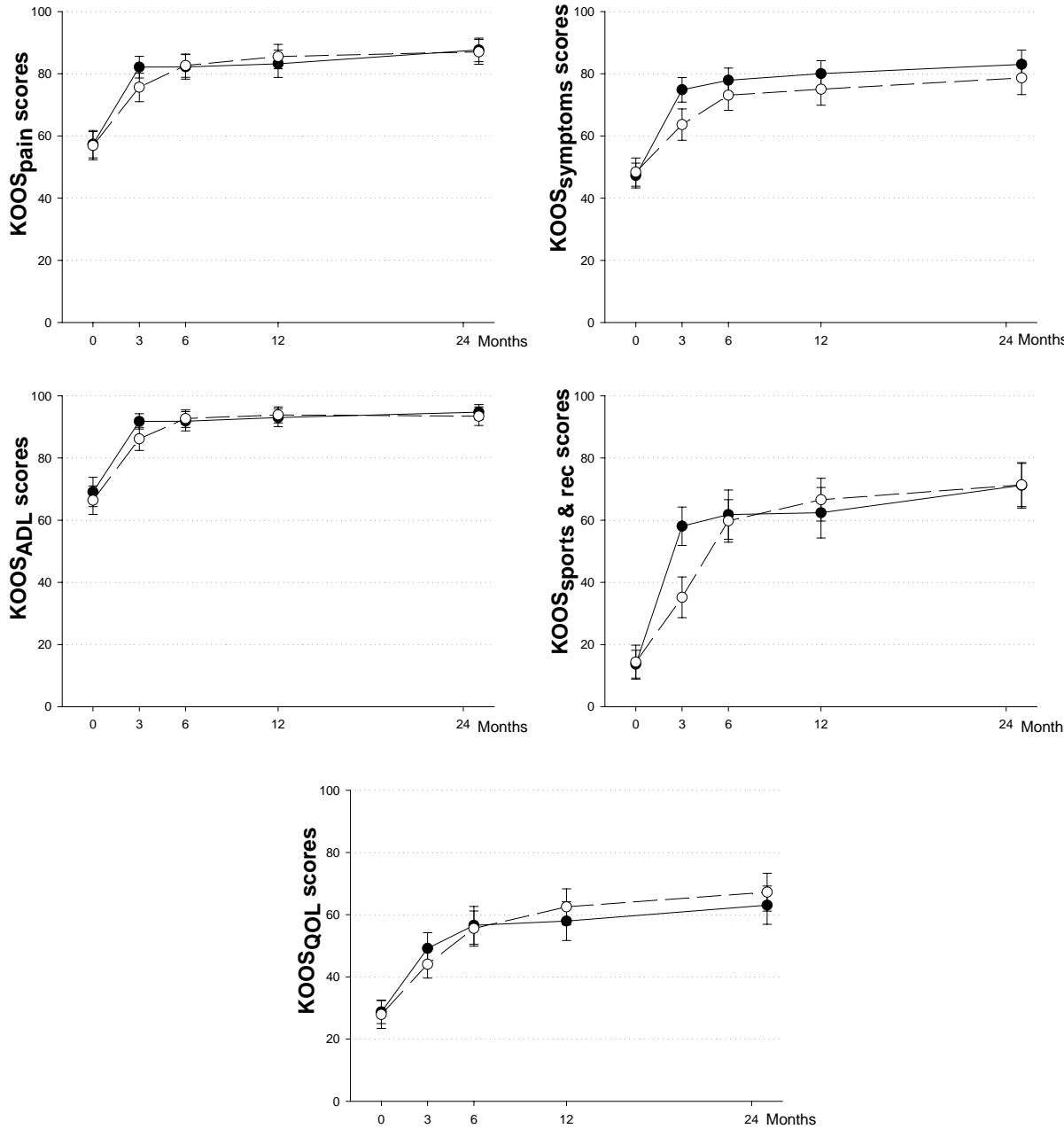
* Note that 2 subjects in this group did not participate in rehabilitation and were thus excluded from this analysis.

Web supplementary table G. Post hoc analysis of primary, secondary and other endpoints at 2 years for the pre-specified as-treated sub-groups: rehabilitation plus early ACL reconstruction [n=60], rehabilitation plus delayed ACL reconstruction [n=23] and rehabilitation alone [n=36].

Post hoc as-treated sub-group analysis							
	Rehabilitation plus early ACL reconstruction (n=60)		Rehabilitation plus delayed ACL reconstruction (n=23)		Rehabilitation alone (n=36)		p-value
<u>2-year follow-up</u>							
Months from randomization, mean (95% CI)	24.6	(24.4 – 24.8)	25.1	(24.7 – 25.6)	24.9	(24.5 – 25.2)	0.04
Months from ACL reconstruction, mean (95% CI)	23.5	(23.3 – 23.6)	13.4	(11.7 – 15.0)	-		<0.001
<u>Primary endpoint</u>							
Change in KOOS ₄ from baseline to 2 years, mean (95% CI) ¹	39.0	(34.2 – 43.7)	39.8	(32.1 – 47.6)	39.2	(33.0 – 45.3)	0.98
<u>Secondary endpoints</u>							
KOOS subscales, mean (95% CI) ²							
Pain	87.2	(83.3 – 91.2)	86.6	(80.5 – 92.7)	88.3	(83.3 – 93.4)	0.97
Symptoms	78.7	(73.5 – 84.0)	81.2	(74.0 – 88.5)	84.1	(77.9 – 90.3)	0.30
Function in daily living	93.5	(90.6 – 96.5)	94.4	(90.7 – 98.2)	94.9	(91.5 – 98.2)	0.87
Function in sport and recreation	71.8	(64.9 – 78.7)	68.5	(56.6 – 80.3)	72.9	(63.3 – 82.5)	0.92
Knee related quality of life	67.3	(61.3 – 73.3)	65.5	(56.5 – 74.5)	61.5	(52.9 – 70.1)	0.44
SF-36, mean (95% CI) ³							
Physical component	82.1†	(77.2 – 87.0)	76.7	(68.5 – 84.8)	78.8	(72.2 – 85.4)	0.36
Mental component	88.3	(85.0 – 91.7)	86.0	(79.4 – 92.7)	82.3	(76.9 – 87.8)	0.17
Tegner activity score, median (25 th , 75 th percentiles) ⁴							
Return to previous activity, n (%) ⁵	6.5	(3, 8)	5	(4, 7)	5	(4, 8)	
	27	(44)	7	(30)	14	(39)	0.56
<u>Exploratory endpoints</u>							
Knee stability tests							
KT-1000 (mm), mean (95% CI) ⁶	6.6†††	(6.0 – 7.2)	7.1	(6.0 – 8.2)	9.0†	(8.0 – 10.0)	0.001
Normal Lachman, n (%) ⁷	39††	(65)	15	(65)	2	(6)	<0.001
Normal pivot shift, n (%) ⁸	45††	(75)	19	(83)	8	(23)	<0.001
Longitudinal change in KOOS (days x points), mean ±SD ⁹	1624	±405	1476	±284	1780	±338	0.008
Severely decreased knee related quality of life, n (%) ¹⁰	11	(18)	11	(48)	5	(14)	0.005

1 KOOS₄ at 2 years includes the Knee injury and Osteoarthritis Outcome Score (KOOS) subscales pain, symptoms, sport and recreation
2 function, knee-related quality of life subscales. KOOS₄ at 2 years, ranging from 0 to100, with higher scores indicating better results.^{19, 20}
3 Scores on the Knee injury and Osteoarthritis Outcome Score (KOOS) ranging from 0 to100, with higher scores indicating better results.^{19, 20}
4 Scores on the SF-36 ranging from 0 to100, with higher scores indicating better results.²⁴
5 The Tegner activity score assesses activity level with specific emphasis on demands of the knee, ranging from 1 to 10 where 1 is least
6 strenuous activity level and 10 corresponds to high knee demanding activities on a professional level.¹²
7 Defined as those returning to the same or higher Tegner activity score as that recorded prior to the injury
8 KT-1000 is an instrumented test to assess antero-posterior laxity of the knee with the result presented in millimeters (mm). The mean of 3
9 trials assessed at 134N are presented.
10 The Lachman test assesses antero-posterior laxity of the knee in a semi-flexed position at rest. Results range from 0 to 3, with 0 indicating
normal stability and 3 indicating severely increased laxity. Knees with normal stability (0) are presented.
The Pivot shift test assesses rotational stability of the knee at rest. Results range from 0 to 3, with 0 indicating normal stability and 3
indicating severely increased laxity. Knees with normal stability (0) are presented.
Area under curve (AUC) analysis, with higher scores indicating better results.
Defined as a patient-reported KOOS_{QOL} score below 44 at any visit between 6 months and 2 years of follow-up.

Web supplementary Figure H. Knee injury and Osteoarthritis Outcome Score (KOOS) subscale scores over time according to treatment group. One subject, assigned to rehabilitation plus ACL reconstruction, did not have data available at 2 interim visits and was thus not included in the graph. Mean scores are shown for the full analysis set (n=120), error bars indicate 95% confidence intervals. Filled circles and solid lines for those assigned to rehabilitation plus optional delayed ACL reconstruction (n=59), open circles and dashed lines for those assigned to rehabilitation plus early ACL reconstruction (n=61).



APPENDIX A: REHABILITATION PROTOCOL OF THE KANON STUDY

The protocol included four levels described by exercise examples and goals for range of motion, muscle function, and functional performance for the first 24 weeks of rehabilitation. Goals for each level should be met prior to progression to the next level. Time intervals for each level were suggested but not superior to the goals. A slower progression was expected in those assigned to rehabilitation plus ACL reconstruction. Pain, swelling and discomfort slowed the progression, and if persistent a visit to the treating clinician was scheduled. Use of anti-inflammatory drugs (NSAID) was allowed if needed.

Examples of exercises appropriate for each phase are presented. These exercises are examples and the Physical Therapist also used complementary exercises complying with the guidelines for each phase.

	0-4 weeks	5-8 weeks	9-12 weeks	13-16 weeks	17-24 weeks
Unloaded range of motion (ROM)	As tolerated	As tolerated	Normal	Normal	Normal
Goals	<i>Full extension Flexion > 120 deg</i>	<i>Full extension Flexion comparable to other side</i>	<i>Comparable to other side</i>	<i>Comparable to other side</i>	<i>Comparable to other side</i>
Muscle function	Quadriceps: unloaded full control Hamstrings: loaded exercises Exercises for other lower limb muscles and trunk are initiated	Quadriceps: loaded non-weight bearing in 40-120 deg and closed-chain (weight bearing) exercises in 0-80 Hamstrings: full ROM Exercises for other lower limb muscles and trunk	Quadriceps: closed-chain exercises without limitations Hamstrings: exercises without limitations Exercises for other lower limb muscles and trunk	Quadriceps: open-chain exercises without limitations Hamstrings: exercises without limitations Exercises for other lower limb muscles and trunk	Quadriceps: open-chain exercises without limitations Hamstrings: exercises without limitations Exercises for other lower limb muscles and trunk
Goals	<i>Full quadriceps control in sitting and standing</i>			<i>Non-surgical: Less than 10% difference in quadriceps and hamstrings strength between legs</i>	<i>Surgical: Less than 10% difference in quadriceps and hamstrings strength between legs</i>

	0-4 weeks	5-8 weeks	9-12 weeks	13-16 weeks	17-24 weeks
Symptoms	Pain: tolerated, treated if necessary Swelling: tolerated, treated if necessary	Pain: tolerated, treated if necessary Swelling: tolerated, treated if necessary	No pain Occasional activity- related swelling tolerated	No pain Occasional activity- related swelling tolerated	No pain Occasional activity- related swelling tolerated
Goals	<i>No morning swelling</i>	<i>No pain Occasional activity- related swelling</i>	<i>No activity-related pain Occasional activity- related swelling</i>	<i>No activity-related pain Occasional activity- related swelling</i>	<i>No activity-related pain Occasional activity- related swelling</i>
Walking	As tolerated forward and backwards without pain* and limping (initially with crutches)	Full weight-bearing Daily walking without restrictions	Full weight-bearing Slow and fast walking on treadmill	Full weight-bearing Running on treadmill/even surface Non-surgical: Unrestricted running	Full weight-bearing Surgical: Unrestricted running
Goals	<i>Full weight-bearing without pain or limping Crutches may be discharged when patient is able to walk backwards without limping</i>	<i>Full weight-bearing Walking without pain or limping</i>	<i>Full weight-bearing Walking without pain, swelling or limping</i>	<i>Full weight-bearing Non-surgical: Running without pain, swelling or limping</i>	<i>Full weight-bearing Surgical: Running without pain, swelling or limping</i>

	0-4 weeks	5-8 weeks	9-12 weeks	13-16 weeks	17-24 weeks
Balance/ Coordination	One-leg standing in functional positions	One-leg standing in functional positions on soft ground and Babs-board	One-leg standing in functional positions on more demanding surfaces and Babs-board	One-leg standing in functional positions on more demanding surfaces Two legged bounces Easy sport-specific movements Easy agility exercises	One-leg standing in functional positions on more demanding surfaces One legged bounces Provoked sport-specific movements Provoked agility exercises
Goals	<i>One-leg standing without difficulties</i>	<i>Comparable to other side</i>	<i>Comparable to other side</i>	<i>Non-surgical: One-legged hop and square-hop¹ less than 10% difference between legs</i>	<i>Surgical: One-legged hop and square-hop¹ less than 10% difference between legs</i>

	0-4 weeks	5-8 weeks	9-12 weeks	13-16 weeks	17-24 weeks
Activities	Unloaded and loaded biking on stationary bike backwards and forwards with clips	Biking on stationary bike without restrictions Wet-vest exercises and running in deep water Non-surgical: Outdoor biking without restrictions	Biking on stationary bike without restrictions Wet-vest exercises and running in deep water Slide-board training	Non-surgical: Introduction of sport-specific exercises Surgical: Outdoor biking without restrictions	Surgical: Introduction of sport-specific exercises
Goals	<i>Unloaded biking forward with clips</i>			<i>Non-surgical: Back to pre-injury activity level</i>	<i>Surgical: Back to pre-injury activity level</i>
Action if goal is not reached		If ROM, Symptoms, Weightbearing goals are not reached: Doctors Visit			

*As tolerated = acceptable pain according to Pain Monitoring System Visual Analog Scale 5 (0-10) (Thomee, R. A comprehensive treatment approach for patellofemoral pain syndrome in young women. Phys Ther 1977(12): 1690-703.

¹ Ostenberg A, Roos E, Ekdahl C, Roos H. Isokinetic knee extensor strength and functional performance in healthy female soccer players. Scand J Med Sci Sports. 1998 (5):257-64.

Phase 1 and 2, 0-8 weeks.

Home program; 2-7 days after injury/operation.

Knee flexion:

Lay on your stomach, bend your injured knee to about 90 degrees and lift your foot and lower leg towards the ceiling.



Knee extension:

Sit in front of a wall with your injured leg slightly bent and a ball under the knee. Put the foot against the wall and press the knee towards the floor. Keep the tension in the knee extensors.



Muscle function:

Sit on a chair/stool. Stand up slowly with full muscle control, equally distributed load on both feet.



Phase 1 and 2. 2-8 weeks after injury/reconstructive surgery

Lay on your back with hips and knees in 90 degrees with your feet against the wall. Slide your injured leg up and down along the wall by extending and flexing your knee.



Stand with your back against the wall and a soft ball behind your injured knee. Squeeze the ball against the wall by extending your knee.



"Norwegian push-ups".
Press a soft ball between your knees, flex and extend your hips and knees. Keep back straight.



Stand on a step board, step down by flexing foot, knee and hip...
Important! Neutral alignment of foot, knee and hip.
Do not lean trunk forward.

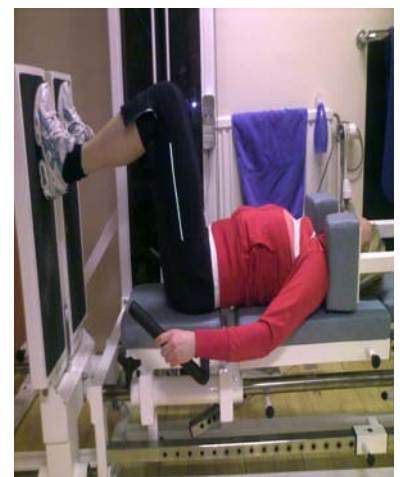
...forward



... to the side



Leg press, start at 90 degrees and extend your legs.



Kneebendings with a stick.
Important! Neutral alignment of foot, knee and hip.
Do not lean trunk forward.



Lay on your back with the injured leg on a hard pillow,
keep your hands around your other knee. Lift your pelvis.



Lay on your back with both legs on the hard pillow. Lift your pelvis
using one leg, move your other leg sideways.
Alternate between legs.



A. Stand with your injured leg slightly bent on the step board.



B. Take one step up with your injured leg and extend your knee. Continue the rise until on your toes, keep the knee extended.



Lean against the board on your injured side. Lift your hip up from the board. Simultaneously, extend and lift the other leg in abduction.



Stand on your injured leg on a balance board with your knee semi flexed.



Stand on your injured leg on a trampoline, flex and extend your knee slightly and slowly with full control.



Stand on your injured leg and slide sideways and back again with your other leg. Use a small towel under the other shoe for sliding.



Phase 4 and 5. 13-24 weeks after injury/reconstruction

Lunges while moving medicine ball from side to side.



Stepping down to the side from stepboard with deep knee bendings.



Leg extensions with resistance.



Stand on your injured leg with your other lower leg resting on a pillow. Flex your injured knee with dumbbells in your hands. Important! Neutral alignment of foot, knee and hip.



Squeeze a soft ball between your knees. Jump forward on both legs over a series of step boards.

