

Supplementary Appendix

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

Supplement to:

Ericsson, Roos, Frobell

Strength and Performance after Exercise Therapy for Acute Anterior Cruciate Ligament Injury in Patients Treated with and without Reconstructive Surgery:

An ancillary Analysis from a Randomized Controlled Trial

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.

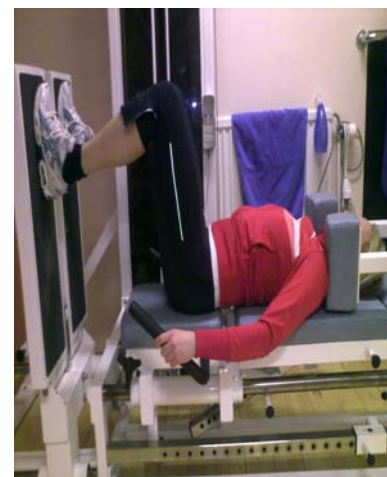
...forward



... 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.

