9. Positioning patient in relation to the hip **Time on video: 33 min. 59 sec.**

With small adjustments the EN-Knee can also be used for the hip.

9.1 Remove back support:

On the reverse side of the EN-Knee there is a handle to loosen the back support. Move the handle to the opposite side and pull out the back-support.

9.2 Fixating handgrip:

The handgrip is an additional equipment that follows the EN-Knee. The handgrip is used when testing and training the hip joint.
After having removed the back support, the handgrip can be inserted. The handgrip is inserted in the same track as the back support. When the optimal position of the handgrip is found, the handle has to be moved back to its original position in order to lock the handgrip. Check that the handgrip is attached firmly.

9.3 Positioning patient:

When training the hip the patient first has to insert the leg between the fixation rolls. Then the patient lies down on the stomach. Make sure that he/she grabs the handgrip for optimal fixation during testing or training.

9.4 Adjusting chair height:

Before any testing or training, the equipment axis has to correspond with the hip joint, as with the knee. Therefore the chair height needs to be adjusted. Turn the black wheel on the right side of the EN-Knee when facing the unit from front, until the equipment axis corresponds with the hip joint.

9.5 Adjusting the lever arm:

The fixation rolls for the leg must be positioned directly above the knee joint. Turn the three handles to firmly attach the fixation for the leg.

9.6 Fixating the patient:

Also when testing/training the hip it is important that the patient is properly fixed. Make sure that the patient lies firmly on the chair, but not inconveniently tight. The movement must be executed unrestrained.
To fixate the patient, one of the fixation belts that follow the EN-Knee can be used. There are two handles at the sides of the EN-Knee, to which the fixation belt can be attached. For proper fixation, it is important that the fixation belt runs over the pelvis and not over the lumbar spine.

9.7 Reading positions of lever arm and chair height:

On the lever arm there is a scale on which you can read the position of the fixation for the leg. Read this position.
There is also a scale on the inner right side of the EN-Knee, as you are facing the unit from front. This scale measures the chair height. Read this position.

After having read the position of the fixation for the lower leg and the position of the chair height, these readings have to be filled into the computer.

Literature:

1. Almekinders, L.C. and Oman, J: Isokinetic Muscle Testing: Is it clinically useful? J. Am. Acad. Orthop. Surgery, 1994 Jul; 2 (4): 221-225

2. Chan, K.M. and Maffulli, N: Principles and Practice of Isokinetics in Sports Medicine and Rehabilitation. Willams & Wilkens Asia-Pacific Ltd. June 1996

3. Dvir, Zeevi: Isokinetics, Muscle testing, Interpretation and Clinical Applications. Churchill Livingstone. 1995

4. ENRAF Nonius: EN-Knee users manual 1-28. Delft, NL. (10/94)

5. Holm, Inger.: Quantification of Muscle Strength by Isokinetic Performance. University of Oslo, Norway. 1996

6. Martin, E.A. Oxford Consise Medical Dictionary. Fifth Edition. Oxford University Press. Oxford UK. (1998)

7. Mellion, M.B: Sports Medicine Secrets. Hanley & Belfus, Inc., Philadelphia. 1994, page 62..

Other sources:

8. Internet site of the European Isokinetic Society (E.I.S) Headquarters: Norholm 112, 2133 HM Hoofddorp (NL) http: www.e-i-s.org

9. Internet site of the Isokinetic Forum http: www.isokinetics.net

10. Internet site of the Online Coach http: www.rownow.com Review article: Stone, M.H. and Stone, M.E.: Training Principles: Evaluation of Modes and Methods of Resistance Training.

11. Catharina Ziekenhuis in Eindhoven

12. Physiotherapie praktijk Verzijden in Boxtel, Vereniging Isokinetica Nederand (V.I.N).

13. May Arna Risberg, Norwegian Physiotherapy Association

Appendix A:
Graphics from the EN-Knee:

Page: 53	**Velocity**	**vs.**	**Time**	**60º/sec.**
Page: 54	**Velocity**	**vs.**	**Position**	**60º/sec**.
Page: 55	**Position**	**vs.**	**Time**	**60º/sec**.
Page: 56	**Torque**	**vs.**	**Time**	**60º/sec**.
Page: 57	**Torque**	**vs.**	**Position**	**60º/sec**.
Page: 58	**Velocity**	**vs.**	**Time**	**120º/sec.**
Page: 59	**Velocity**	**vs.**	**Position**	**120º/sec**.
Page: 60	**Position**	**vs.**	**Time**	**120º/sec**.
Page: 61	**Torque**	**vs.**	**Time**	**120º/sec**.
Page: 62	**Torque**	**vs.**	**Position**	**120º/sec**.
Page: 63	**Velocity**	**vs.**	**Time**	**180º/sec.**
Page: 64	**Velocity**	**vs.**	**Time**	**180º/sec**.
Page: 66	**Torque**	**vs.**	**Time**	**180º/sec**.
Page: 67	**Torque**	**vs.**	**Position**	**180º/sec**.
Page: 68	**Velocity**	**vs.**	**Time**	**240º/sec.**
Page: 69	**Velocity**	**vs.**	**Position**	**240º/sec**.
Page: 70	**Position**	**vs.**	**Time**	**240º/sec**.
Page: 71	**Torque**	**vs.**	**Time**	**240º/sec**.
Page: 72	**Torque**	**vs.**	**Position**	**240º/sec**.

Appendix B:
Used terminology and conceptions:

- **Terminology and abbreviations:**
  - **ACL** – Anterior Cruciate Ligament
  - **AKP** – Anterior Knee Pain
  - **Angle Specific Torque (AST) –** The torque delivered at a certain angle
  - **Angular velocity –** Angular distance travelled in a time interval expressed in degrees per second (°/s) or radials per second (rad/s, at which 360° = 2 π, 1 π rad = 57, 3°).
  - **AP -** Average Power
  - **CKCE –** Close Kinetic Chain Exercises
  - **CV -** Coefficient of Variation
  - **Concentric contraction** – The distance between Origin and Insertion of the muscle decreases whereas the muscle contracts.
  - **Eccentric contraction –** The distance between Origin and Insertion of the muscle increases whereas the muscle contracts.
  - **Extension –** The act of extending or stretching, especially the muscular movement by which a limb is straightened.
  - **Flexion -** The bending of a joint so that the bones forming it are brought towards each other.
  - **Force** – Push or pull exercised on (or by means of) a subject with a magnitude and a direction, expressed in Newton (N).
  - **Isoinertial contraction –** Contraction against a constant (external) resistance.
  - **Isometric contraction –** Contraction with velocity 0, also called static contraction.
  - **Isokinetic contraction –** Contraction with constant velocity (also against a variable resistance).
  - **Isotonic contraction –** The force of the muscle is constant during the total motion (isotonic contraction is often explained as a motion against a constant resistance, whereby the variation of the lift arm and the muscles is not taken into account).
  - **Maximum torque –** Peak Torque, the most used isokinetic parameter. Peak Torque refers to the largest torque delivered during the movement over the range of motion.

- **Muscle strength –** The maximal force a muscle or a muscle group can generate.
- **Newton (N) –** Unity of force. 1 Newton can give a 1kg mass an acceleration of 1 m/s^2.
- **OKCE -** Open Kinetic Chain Exercises
- **PT -** Peak Torque
- **Power –** The amount of work performed per time unit, or force x velocity, expressed in watt (W).
- **ROM** - Range of motion
- **Range of movement –** The angle change in a joint. As motion is a relative conception it is important that a zero-point and a motion direction is defined.
- **Torque –** A force on a distance of an axis, which can give the axis a rotating motion, expressed in Newton x metre (Nm).
- **TW -** Total work
- **Velocity –** Distance travelled in a time interval, expressed in metres per second (m/s).
- **Work –** Product of force and distance travelled, formally the amount of energy delivered by a force of 1 N, which moves a subject 1 metre in the direction of the force, expressed in Joule (J).

- **Conceptions**

  - **Linear system**

Physical quantity	Symbol	SI unit
Acceleration	a	ms^2
Displacement	r	m
Force	F = ma	N
Mass	m	kg
Power	P = Fv	W
Velocity	v	ms
Work	W = Fds	J

  - **Rotatory system**

Physical quantity	Symbol	SI unit
Angle (1rad = 57,69 degrees)	ϕ	rad
Angular velocity	ω	rad s
Angular acceleration	α	rad s^2
Mass moment of inertia	I	kg m^2
Torque	$T = I\alpha$	Nm
Work	$W = Md\phi$	J
Power	$P = T\omega$	W

Appendix C:
Reference values: peak torque's and hamstrings-quadriceps ratio's:

- **Peak torques (Nm):**

Study and population	Sex	Age	Dominant extension	Non-dominant extension	Dominant flexion	Non-dominant flexion
			30 degrees / sec.			
Hageman et al (1989)	M	21 – 33	263,8	248,8	145,0	154,2
Normal	V	21 – 33	147,7	145,9	82,2	88,5
Colliander & Tesch (1989)	M	27	422,0		242,0	
Normal						
			60 degrees / sec.			
Nicholas et al (1988)	M	20 – 30	147,8		101,7	
Normal	V	20 – 30	103,1		57,0	
Lucca & Kline (1989)	M	21	209,1	220,6	133,2	126,8
Normal	V	21	131,1	132,1	84,8	86,1
			90 degrees / sec.			
Hanten & Ramberg (1988)	V	25	154,9			
Normal						
Colliander & Tesch (1989)	M	27	363,0		225,0	
Normal sporters	V	27	227,0		139,0	
			150 degrees / sec.			
Hanten & Ramberg (1988)	V	25	128,5			
Normal						
Colliander & Tesch (1989)	M	27	308,1		209,0	
Sporters	V	27	184,0		129,0	
			180 degrees / sec.			
Wyatt & Edwards (1981)	M	29	132,9	130,2	104,4	100,3
Normal	V	28	78,6	75,9	62,4	61,0
Hageman et al (1988)	M	21 – 33	183,5	167,9	141,0	154,0
Normal	V	21 – 33	97,9	98,9	81,8	88,5
			240 degrees / sec.			
Lucca & Kline	M	21	129,8	132,9	91,9	95,1
Normal	V	21	74,3	74,3	63,1	60,7
			300 degrees / sec.			
Wyatt & Edwards (1981)	M	29	90,9	88,1	74,6	71,9
Normal	V	27	51,5	51,5	43,4	43,4

From Isokinetic Exercise and Assessment, David H. Perrin (1993).

- **Hamstring – quadriceps ratio:**

Study and population	Sex	Age	Dominant H / Q ratio	Non-dominant H / Q ratio
			30 degrees / sec.	
Hageman et al (1989)	M	21 – 33	0,55	0,62
Normal	V	21 – 33	0,59	0,62
			60 degrees / sec.	
Lucca & Kline (1989)	M	21	0,66	0,58
Normal	V	21	0,66	0,67
			90 degrees / sec.	
Colliander & Tesch (1989)	M	27	0,63	
Normal athletes	V	27	0,61	
			150 degrees / sec.	
Colliander & Tesch (1989)	M	27	0,69	
Normal athletes	V	27	0,70	
			180 degrees / sec.	
Hageman et al (1988)	M	21 – 33	0,76	0,88
Normal	V	21 – 33	0,84	0,87
			240 degrees / sec.	
Lucca & Kline (1989)	M	21	0,71	0,72
	V	21	0,86	0,82

From Isokinetic Exercise and Assessment, David H. Perrin (1993).

Appendix D:
Example of a test form:

Personal data:

Patient:
Date of Birth:
Address:
Postal Code:
Place of residence:
Profession:
Sport:

Complaint:

Doctor:
Eventual operation-date: … - … -2001.
Remarks:

Test: Knee/Hip	Fixation: Ankle roll: Back-support: Sitting:		Test date: 1/ … - … - 2001 2/ … - … - 2001 3/ … - … - 2001
Speed:	Peak-Torque Left Side	Peak-Torque Right Side	ROM Left ROM Right
60°/ second	1 /…...…….Nm 2 /……...…….Nm 3 /……...…….Nm 4 /……...….Nm 5 /…….....Nm	1 /…...…….Nm 2 /……...…….Nm 3 /……...…….Nm 4 /……...….Nm 5 /…….....Nm	Remarks Remarks
180°/second	1 /……..……..Nm 2 /……..……...Nm 3 /……..…...Nm 4 /…….....Nm 5 /……Nm	1 /…...…….Nm 2 /……...…….Nm 3 /……...…….Nm 4 /……...….Nm 5 /…….....Nm	Remarks Remarks
240°/second	1 /……Nm 2 /……Nm 3 /…….....Nm 5 /……...….Nm 10 /……..…….Nm 15 /……..…….Nm 20 /……..…….Nm	1 /……Nm 2 /……Nm 3 /…….....Nm 5 /……...….Nm 10 /……..…….Nm 15 /……..…….Nm 20 /……..…….Nm	Remarks Remarks