

# Self-efficacy of knee function

*in patients with an Anterior Cruciate Ligament injury*

*Pia Thomeé*



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Göteborg 2007

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“Consciousness is the very substance of mental life that not only makes life personally manageable but worth living. A functional consciousness involves purposive accessing and deliberative processing of information for selecting, constructing, regulating, and evaluating courses of action.”

Albert Bandura  
Social Cognitive Theory: An Agentic Perspective, 2001



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# This thesis

This thesis comprised of exploring perceived *self-efficacy of knee function* in patients with an ACL injury. In *Study I*, an instrument to measure self-efficacy of knee function, the Knee Self-Efficacy Scale (K-SES), was designed and evaluated. *Study II* investigated the measurement of change (responsiveness) of the K-SES. In *Study III*, factors that were considered important and having a major impact on self-efficacy of knee function were explored. *Study IV* explored the potential of the K-SES to predict the outcome of rehabilitation after an ACL reconstruction.

## Study I

The new instrument  
K-SES was developed

A. Dagliga aktiviteter  
Kryssa i rutan för den siffra som bäst beskriver hur säker du är på din förmåga att kunna utföra aktiviteten *just nu* oavsett smärta/besvär.

Hur säker är du på att: 0 = inte alls säker 10 = mycket säker

1) gå i skogen	<input type="checkbox"/>
2) gå nedför backar/trappor	<input type="checkbox"/>
3) gå ut och dansa	<input type="checkbox"/>
4) hoppa ihop från en höjd	<input type="checkbox"/>
5) springa efter små bollar	<input type="checkbox"/>
6) springa till spårspår/bana	<input type="checkbox"/>
7) arbeta i trädgården	<input type="checkbox"/>

B. Fritids-, motions- och idrottsaktiviteter  
Kryssa i rutan för den siffra som bäst beskriver hur säker du är på din förmåga att kunna utföra aktiviteten *just nu* oavsett smärta/besvär.

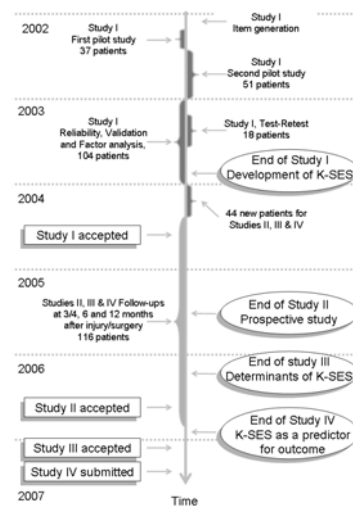
Hur säker är du på att: 0 = inte alls säker 10 = mycket säker

1) cykla längre sträckor	<input type="checkbox"/>
2) åka längskidor	<input type="checkbox"/>
3) rida	<input type="checkbox"/>
4) simma	<input type="checkbox"/>
5) fjällvandring	<input type="checkbox"/>

Tilltro till sin förmåga för patienter med följande korsbandsskada  
Version 4, Copyright Pia Thomee 2003

## Study II

K-SES was sensitive  
to changes over time



## Study IV

Self-efficacy predicted physical activity,  
symptoms and muscle function



## Study III

Self-efficacy was characterised by  
symptoms, function and internal  
locus of control





## List of papers

This thesis is based on the following studies, referred to in the text by their Roman numerals:

- I. Thomeé P, Währborg P, Börjesson M, Thomeé R, Eriksson BI, Karlsson J. A new instrument for measuring self-efficacy in patients with an Anterior Cruciate Ligament injury. *Scand J Med Sci Sports* 16;181-187:2006.
- II. Thomeé P, Währborg P, Börjesson M, Thomeé R, Eriksson BI, Karlsson J. Self-efficacy, symptoms and physical activity in patients with an Anterior Cruciate Ligament injury: a prospective study. *Scand J Med Sci Sports* 2006. [Epub ahead of print]
- III. Thomeé P, Währborg P, Börjesson M, Thomeé R, Eriksson BI, Karlsson J. Determinants of self-efficacy in the rehabilitation of patients with an Anterior Cruciate Ligament injury. *Accepted for publication in Journal of Rehabilitation Medicine* 2007.
- IV. Thomeé P, Währborg P, Börjesson M, Thomeé R, Eriksson BI, Karlsson J. Self-efficacy of knee function as a pre-operative predictor of outcome one year after Anterior Cruciate Ligament reconstruction. *Submitted for publication* 2007.

## Abstract

### *Self-efficacy of knee function in patients with an Anterior Cruciate Ligament injury*

The overall purpose of this thesis was to investigate the clinical relevance of *perceived self-efficacy of knee function* among patients with an Anterior Cruciate Ligament (ACL) injury.

*Study 1:* The purpose was to develop an instrument for measuring perceived self-efficacy of knee function in patients with an ACL injury. A total of 210 patients with an ACL injury participated in the study. Items were generated and analysed and the final Knee Self-Efficacy Scale (K-SES) was tested for reliability and validity. A factor analysis revealed two factors that should be treated as separate sub-scales; how the patients perceived their *present* physical performance/function (K-SES<sub>Present</sub>) and how the patients perceived their *future* physical performance/prognosis of their knee (K-SES<sub>Future</sub>). The K-SES was found to be reliable and valid for perceived self-efficacy of knee function in patients with an ACL injury.

*Study 2:* The purpose was to describe perceived self-efficacy of knee function prospectively up to one year after ACL injury/surgery. The purpose was also to describe the influence of symptoms, gender, age and physical activity on the patients' perceived self-efficacy of knee function. Thirty patients with a recent ACL injury and 33 patients with an ACL reconstruction participated. The perceived self-efficacy of knee function changed significantly during the course of rehabilitation. There was also a significant increase between each test occasion up to six months for patients with an ACL injury and up to twelve months for patients who had undergone surgery. The improvement in perceived self-efficacy of knee function could, however, only be partly explained by the improvement in subjective symptoms. Furthermore, a significant difference in self-efficacy of knee function was observed early in the rehabilitation process, between men and women, both young and old, and patients with a low and high pre-injury physical activity level.

*Study 3:* The purpose was to explore physical and psychological measures believed to determine patients' perceived self-efficacy of knee function in the rehabilitation of patients with an ACL injury. One year after ACL injury or reconstructive surgery, 116 patients were tested for their self-efficacy of knee function and for 15 outcome measures. A stepwise linear regression analysis was conducted on the K-SES to detect the strongest model describing self-efficacy of knee function. The Lysholm score, KOOS<sub>Sports/Recreation</sub>, Internal Locus of Control and Locus of Control by Chance explained 40% of the variance in the complete K-SES as well as 41% of the variance for K-SES<sub>Present</sub>. The strongest model, explaining 38% of the variance for K-SES<sub>Future</sub>, was the Lysholm score, KOOS<sub>Sports/Recreation</sub>, Tegner<sub>Present</sub> level, and Internal Locus of Control.

*Study 4:* The purpose was to explore the potential of the K-SES to predict outcome one year after an ACL reconstruction. Thirty-eight patients scheduled for an ACL reconstruction were evaluated pre-operatively using the K-SES. One year after surgery, patients were evaluated using outcome measures for present physical activity, knee symptoms and knee muscle function. K-SES<sub>Present</sub> and K-SES<sub>Future</sub> were found to be significant predictors pre-operatively of present physical activity, knee symptoms and knee muscle function one year after ACL reconstruction, when adjusted for age, gender and pre-injury physical activity level (Tegner<sub>Pre-injury</sub>).

**Conclusion:** The K-SES was found to be a reliable, valid and responsive instrument to be used for assessing self-efficacy of knee function in patients with an ACL injury. The possible determinants of the K-SES may help both to provide a better understanding of some of the underlying factors characterising self-efficacy of knee function and to improve strategies in the rehabilitation of patients with an ACL injury. Clinicians may consider using the K-SES in order possibly to predict the outcome after ACL surgery and rehabilitation.

**Key words:** self-efficacy of knee function, K-SES, anterior cruciate ligament injury, test instrument construction, validity, reliability, responsiveness, determinant, predictor

## Summary in Swedish

### *Tilltro till sin förmåga när det gäller knäfunktion hos patienter med främre korsbandsskada*

#### *Syfte*

Syftet med avhandlingen var att undersöka betydelsen av tilltro till sin förmåga när det gäller knäfunktion för patienter som skadat sitt främre korsband.

#### *Metod*

Totalt 210 patienter med en främre korsbandsskada deltog i avhandlingens första studie för att ta fram och utvärdera ett nytt instrument, benämnt *knee self-efficacy scale (K-SES)*, för att mäta tilltro till sin förmåga. Relevanta aktiviteter/situationer för den korsbandsskadade patienten formulerades och analyserades, och det slutgiltiga mätinstrumentet testades för reliabilitet (mätnoggrannhet, tillförlitlighet) och validitet (att instrumentet mäter det som avses att mäta). I Studie II, en prospektiv studie, beskrevs tilltro till sin förmåga vid fyra tillfällen under ett år efter skada/operation. Trettio patienter som nyss skadat sitt främre korsband och 33 patienter opererade med en rekonstruktion av främre korsbandet deltog i studien. Betydelsen av knäsymtom, ålder, kön och fysisk aktivitetsnivå för patientens tilltro till sin förmåga utvärderades. I Studie III, en explorativ deskriptiv studie, utvärderades 116 patienter ett år efter skada/operation avseende fysiska och psykiska faktorer som ansågs viktiga och avgörande för tilltro till sin förmåga. En linjär regressionsanalys genomfördes för att beskriva den starkaste förklaringsmodellen i variationen av tilltro till sin förmåga. I studie IV utvärderades, i en explorativ deskriptiv studie av 38 patienter, om patientens tilltro till sin förmåga mätt med K-SES strax före operation kunde predicera (förutspå) ett-års-resultatet avseende fysisk aktivitet, knäsymtom och muskelfunktion.

### **Resultat**

*Studie 1:* K-SES visade sig ha god reliabilitet och god validitet för att mäta tilltro till sin förmåga när det gäller knäfunktion hos patienter med en främre korsbandsskada och hos patienter opererade med en rekonstruktion av främre korsbandet. En faktoranalys gav två viktiga faktorer för K-SES. Faktor 1 var *nuvarande tilltro* till sin förmåga, benämnt K-SES<sub>Just nu</sub> och faktor 2 var *framtida tilltro* till sin förmåga, benämnt K-SES<sub>Framtid</sub>.

*Studie 2:* Tilltro till sin förmåga förändrades signifikant under första året efter skada/operation, vilket bara delvis kunde förklaras av förändring av symtom. K-SES kunde dessutom upptäcka förändringar som var kliniskt relevanta för symtom och funktion. Tidigt i rehabiliteringen skiljde sig signifikant tilltro till sin förmåga mellan män och kvinnor, yngre och äldre, och patienter med hög och låg aktivitetsnivå.

*Studie 3:* Lysholm score (symtom), KOOS<sub>Sport/Rekreation</sub> (symtom under sport och rekreation), Internal Locus of Control (om patienten själv ansåg sig kunna påverka sin hälsa) och Locus of Control by Chance (om patienten ansåg att hälsan påverkades av tur/otur) förklarade 40% av variationen för totala K-SES, liksom 41% av variationen för K-SES<sub>Just nu</sub>. För K-SES<sub>Framtid</sub> var den starkaste modellen; Lysholm score (symtom), KOOS<sub>Sport/Rekreation</sub> (symtom under sport och rekreation), Tegner<sub>Just nu</sub> (fysisk aktivitet just nu) och Internal Locus of Control (om patienten själv ansåg sig kunna påverka sin hälsa), som förklarade 38% av variationen.

*Studie 4:* K-SES<sub>Just nu</sub> och K-SES<sub>Framtid</sub> mätt före operation var signifikanta prediktorer för fysisk aktivitet, symtom och muskelfunktion ett år efter främre korsbandsrekonstruktion justerat för ålder, kön och fysisk aktivitetsnivå före skadan.

### **Sammanfattning:**

K-SES hade god reliabilitet, validitet och var känsligt över tid för förändringar i tilltro. Viktiga och avgörande faktorer för tilltro till sin förmåga när det gäller knäfunktion ett år efter skada/operation var hur patienten ansåg sig uppleva sina symtom under utövande av sport- och rekreationsaktiviteter, liksom om patienten ansåg sig själv kunna påverka sin hälsa. Patientens tilltro till sin förmåga när det gäller knäfunktion mätt före operation med K-SES kan predicera (förutsäga) resultatet när det gäller patientens knäsymtom, fysiska aktivitet och muskelfunktion ett år efter operation.

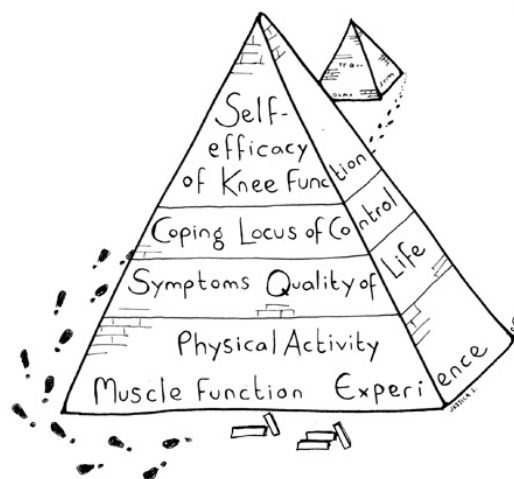
## Thesis at a glance

### *Study I – Is it possible to design an instrument to evaluate perceived self-efficacy of knee function?*

**Patients:** 210 patients with an ACL deficient or ACL reconstructed knee.

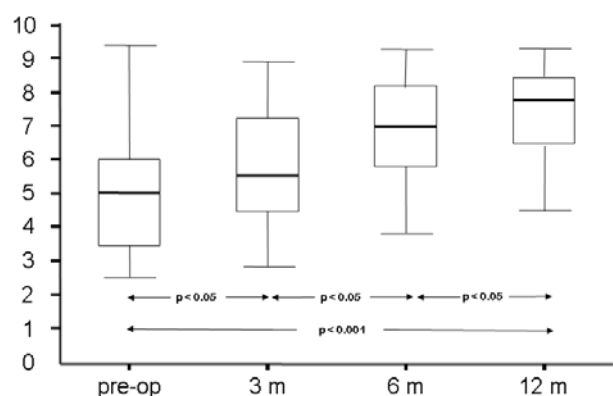
**Methods:** Item generation, item analysis, factor analysis, and evaluation of reliability and validity.

**Conclusion:** Good reliability and validity were demonstrated for the instrument Knee Self-Efficacy Scale (K-SES), measuring perceived self-efficacy of knee function in patients with an ACL injury.



Initially it was hypothesized that the outcome of ACL rehabilitation was dependent on the base of the pyramid. Self-efficacy was of potential interest.

### *Study II – Does the patients' self-efficacy of knee function change and can this be measured by the K-SES?*



**Patients:** 30 recently injured patients with an ACL deficient knee and 33 patients scheduled for ACL reconstruction.

**Methods:** A one-year prospective study with four evaluations of the patients' self-efficacy of knee function during the year.

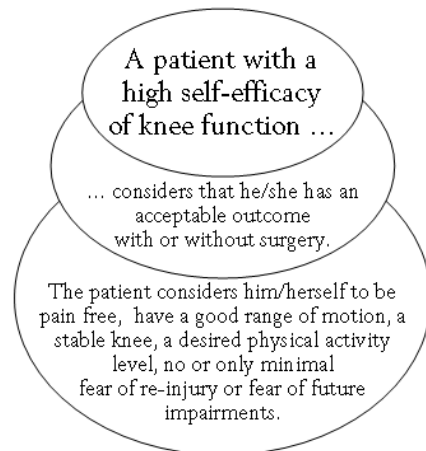
**Conclusion:** Self-efficacy of knee function, as measured by the K-SES, increased significantly during rehabilitation in patients with an ACL injury, as well as in patients who had undergone ACL reconstruction.

***Study III – Which factors are important and have a major impact on patients’ perceived self-efficacy of knee function?***

**Patients:** 116 patients with an ACL deficient or ACL reconstructed knee.

**Methods:** An explorative study, one year after injury or surgery.

**Conclusion:** Patients who have strong self-efficacy of knee function consider themselves to have less knee symptoms, better knee function and that their outcome after injury or surgery is directly related to their individual behaviour.



This thesis has resulted in the new hypothesis that the patients’ perceived self-efficacy of knee function has a major influence on the outcome of ACL rehabilitation

***Study IV – Can patients’ perceived self-efficacy of knee function predict outcome of rehabilitation after an ACL injury?***

**Patients:** 38 patients were evaluated pre-operatively and one year after an ACL reconstruction.

**Methods:** A one-year explorative study.

**Conclusion:** This study indicates that patients' perceived self-efficacy of knee function pre-operatively is of predictive value for their return to acceptable levels of physical activity, symptoms and muscle function one year after ACL re-construction.

## **Abbreviations and definitions**

ACL	Anterior Cruciate Ligament
ACL injury	Term used in this thesis for patients with an ACL-deficient knee, i.e. patients that have not undergone ACL reconstruction
$\beta$ -value	The estimated change in the dependent variable for a one-unit increase in the predictor, used in a linear regression
Construct validity	The extent to which a measure correlates with measures of other variables in ways that can be explained theoretically <sup>100</sup>
Content validity	A judgement of whether the instrument samples all the relevant or important content or domains <sup>100</sup>
Convergent	How closely the instrument or measure relates to another measure of the same construct to which it should be related <sup>100</sup>
Coping strategies	The individual's resources for handling major stressors
Cronbach's alpha	A method for calculating internal consistency
CSQ	The Coping Strategies Questionnaire
Determinant	A factor that is important and has a major impact on the task under consideration
Face validity	A subjective judgement by experts in the field that items appear to assess the desired qualities <sup>100</sup>
Factor analysis	Identifies the underlying dimensions of a domain of functioning, as assessed by a particular measurement instrument
ICC	Intra-class correlation coefficient
Item	A single statement or question



## Abbreviations and definitions

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Internal Consistency	A reliability test based on a single administration of the measure. It measures whether a large number of items address the same underlying dimension. Each item score is expected to correlate with all the other items on that measure
Health locus of control	A measure of people's beliefs that their health is or is not determined by their behaviour
Harris Kaiser's Rotation method	The factor analysis method used in Study I
KOOS	The Knee Injury and Osteoarthritis Outcome Score
K-SES	The Knee Self-Efficacy Scale K-SES, the Swedish version, can be downloaded from: <a href="http://www.orthopaedics.gu.se/forskning/avhandlingar">www.orthopaedics.gu.se/forskning/avhandlingar</a>
K-SES <sub>ABCD</sub>	The same as K-SES <sub>Total</sub> , used to evaluate the patients' overall self-efficacy of knee function
K-SES <sub>ABC</sub>	The same as K-SES <sub>Present</sub> , used to evaluate the patients' present self-efficacy of knee function
K-SES <sub>D</sub>	The same as K-SES <sub>Future</sub> , used to evaluate the patients' future self-efficacy of knee function
MHLC	The Multidimensional Health Locus of Control
Odds ratio	The ratio of the odds ( $p/(1-p)$ ) for a one-unit increase in the predictor, used in a logistic regression
Outcome	A response variable that adequately quantifies the success (or failure)
PAS	The Physical Activity Scale
Predictor	An indicator of the outcome
QoL	Quality of Life

## Abbreviations and definitions

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Responsiveness	Also known as sensitivity to change. It is the ability of a measure to detect a change when a change has occurred. In particular, it measures how well an instrument can detect changes in response to some intervention <sup>101</sup>
$r_s$	Spearman's rank correlation coefficient
$R^2$	How much of the variation in the dependent variable that is explained by all the predictors in the model, used in a linear regression
State	How a person interprets the situation at a given moment in time
Tegner scale	The Tegner activity grading scale
Trait	A personality characteristic
Transformation by Blom	A transformation of a dependent variable to a normal distribution, making calculations possible for the multiple regression analysis

# Introduction

### *Brief history of the ACL injury*

The anterior cruciate ligament (ACL), one the most important passive stabiliser of the knee, was first described by Hippocrates (460-377 BC). He thought that a subluxation of the knee was associated with an injury to this ligament. The stabilising function of the ACL was first described in 200 AC by Claudius Galenos, who thought that the ACL was a large nerve in the knee joint. The first known detailed description of the mechanics of knee-joint motion was given by the Weber brothers in 1836. They also described the abnormal kinematics correlated to an ACL injury<sup>110</sup>. Nowadays, we know that faulty kinematics in the knee joint are involved in the development of osteoarthritis, found in approximately 50% of patients 10-15 years after an ACL injury<sup>58,89</sup>. The “subluxation”, described nowadays as the “giving-way” of the knee, as well as the functional consequences of the “subluxation”, was first described in detail in the middle of the 19<sup>th</sup> century<sup>24</sup>. Already at that time, the ACL injury was treated in multiple ways with the goal of ensuring a stable knee. Battle<sup>19</sup> was the first author to publish a report on a successful repair of the ACL, including a two-year follow-up.

Arthrodesis, i.e. making the knee joint stiff, was the only “successful” treatment method for stabilising the knee in Sweden until the 1930s, when Palmer<sup>83</sup> experimented on reconstructing the ACL, with the aim of restoring knee function. With Palmer’s comprehensive thesis in 1938, the modern era of treating the anterior cruciate ligament injury began. Extensive clinical work and research has since improved methods for restoring knee function after an ACL injury<sup>58</sup>.

ACL reconstructive techniques have been extensively developed during the last 15 years, achieving faster, safer and better surgical outcomes. Improvements have resulted in the patient experiencing less pain and knee stiffness, earlier and faster rehabilitation and, in most cases, an earlier return to sports<sup>44,90</sup>. It has been suggested, for an ideal treatment outcome after ACL injury, that the patient should ideally have a strong and stable knee, regain good capacity for physical activity, be free of knee pain, have good knee range of motion, as well as no post-traumatic knee arthritis<sup>2,44,90</sup>. Despite major improvements in terms of understanding knee biomechanics, diagnostic evaluation and surgical and rehabilitation methods over the last 20 years, patients with an ACL injury often end up with a significantly reduced physical capacity<sup>44,67</sup>.

### *Surgery versus no surgery*

It still remains to be elucidated whether early or late reconstruction is to be preferred and whether in fact surgery is needed at all<sup>35,42,59,61</sup>. According to Fithian and co-workers<sup>42</sup> high-risk patients, i.e. the ones with a high level of sports participation prior to their injury, are believed to require surgery in order to resume their previous level of sports participation. Low-risk patients, with a low level of sports participation prior to their injury, are usually not recommended surgery, while, in the case of the so-called moderate risk patients, it is usually a matter of choice for the patient and the surgeon<sup>42</sup>. This algorithm is based on clinical experience, as no randomised study has yet evaluated the need for surgery.

Non-surgical treatment has been shown to produce good knee function but also failures in terms of chronic instability<sup>31,61,98</sup>. Early activity modification and neuromuscular rehabilitation was shown to result in a good outcome in terms of knee function and an acceptable activity level 15 years after ACL injury<sup>61</sup>. In a five-year follow-up study of non-surgically treated patients, the general outcome was reasonably satisfactory according to Casteleyn and co-workers<sup>31</sup>, who found no prognostic effect in terms of age, activity levels, or the incidence of associated lesions. The difference in rehabilitation success may also be associated with individual differences. Rudolph and co-workers<sup>92</sup>, as well as Eastlack and co-workers<sup>38</sup>, have been able to discriminate between so-called copers who, at an early stage in the rehabilitation process, compensate well for the ACL injury on a screening examination compared with non-copers. Their screening examination includes muscle function tests, hopping tests and self-report questionnaires<sup>43</sup>. They have suggested that copers may have a successful rehabilitation without surgery and that non-copers will require surgery<sup>38,92</sup>.

Almekinders and Dedmond<sup>1</sup> underline the importance of preparing the patient to understand the seriousness of the injury before initiating any kind of treatment, especially invasive methods like surgery. A video for a pre-operative modelling intervention was shown to be effective in the early phase of rehabilitation for patients with an ACL injury. It reduced the patients' perception of anxiety and pain and increased post-operative self-efficacy of performing rehabilitation tasks, as well as walking with or without crutches, up to six weeks after an ACL reconstruction<sup>74</sup>. Taken as a whole, it is still unclear who needs surgery, patients with a high/low level of sports participation or copers/non-copers. The mental and physical preparation during rehabilitation may also make a difference to the surgical outcome.

## *Rehabilitation*

The post-injury and post-operative rehabilitation of patients with an ACL injury is considered to be of major importance for an acceptable clinical outcome. There is, however, a need to analyse what is needed in the rehabilitation to restore the injured or reconstructed knee.

Several details have been emphasised in recent research on the rehabilitation of patients with an ACL injury. Studies include early active extension exercises after surgery<sup>51</sup>, whether it is possible to accelerate the rehabilitation process<sup>22,96</sup> or not, whether closed chain or open chain exercises should be used<sup>10,30,63,77</sup>, whether stability is jeopardised by using certain exercises<sup>50,21</sup> and how strength training should be effectively implemented<sup>11</sup>. Furthermore, the functional stability of the knee is currently believed to be restored by training functional abilities and muscular strength. No rehabilitation programme has, however, been shown to be good enough fully to restore muscle size and strength for the majority of patients, within the first six to 12 months after ACL injury<sup>4,7,11,87,111</sup>. The importance of reduced capacity in terms of muscle strength is discussed and believed to be one of the reasons explaining the reduced physical activity level in patients after ACL injury and surgery<sup>38,67</sup>.

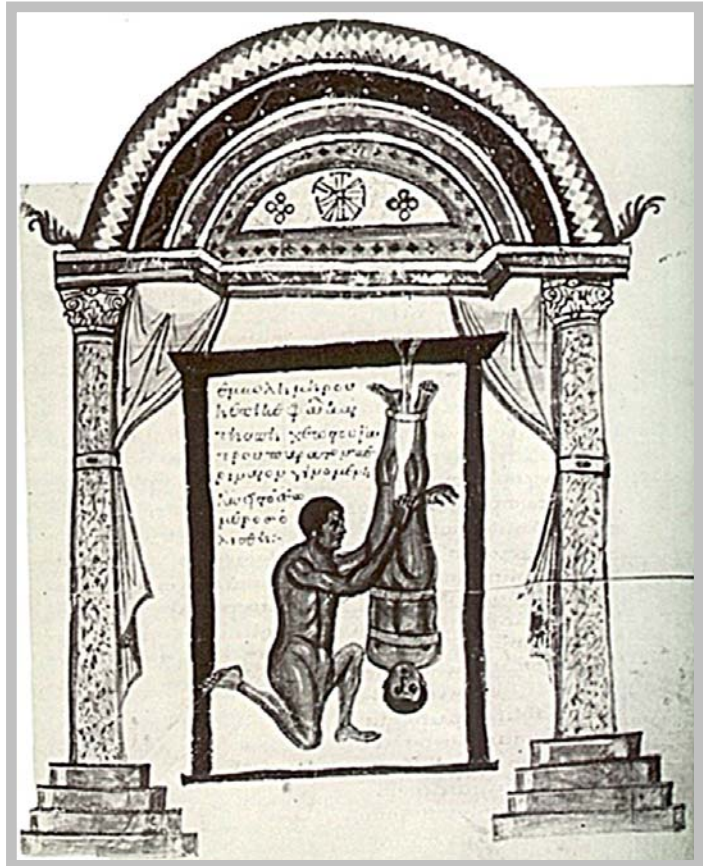


Figure 1 – Rehabilitation methods after a knee injury have come a long way. This picture from the 11<sup>th</sup> century illustrates a treatment method for reducing a dislocation of the knee, Biblioteca Medicea-Laurenziana, Florence<sup>71</sup>.

Several other factors that need to be considered during the rehabilitation of patients with an ACL injury have been described in the literature. They include the “desired” activity level for the choice of treatment<sup>59</sup>, internal health beliefs<sup>82</sup>, previous experience of injury<sup>55</sup>, and psychological risk factors for rehabilitation<sup>56</sup>. Another factor that has been suggested to be of major importance for the rehabilitation outcome after sports-related injuries is the patients’ involvement in the rehabilitation process and their perceived self-efficacy<sup>34</sup>.

### *Success rate for outcome*

As a general rule, a well-functioning, stable knee is needed for the patients to return to high-risk pivoting and twisting knee activities. Successful rehabilitation and/or surgery is needed to accomplish good knee function and patient satisfaction with the outcome<sup>60</sup>. Fear of re-injury or kinesiphobia may, however, be a psychological obstacle to returning to sports activities after an ACL reconstruction<sup>62</sup>. At present, there are no standardised, objective criteria for assessing an athlete’s ability to progress through the end stages of rehabilitation to a safe return to sports<sup>43,80</sup>. Even though patients have undergone seemingly successful rehabilitation and/or ACL reconstruction, there are a number of patients who are unable or unwilling to return to their previous level of physical activity for different reasons, such as insufficient mental planning, low previous or desired activity level, health locus of control and perceived physical function<sup>53,56,82</sup>. According to Johnson<sup>56</sup>, athletes who do not return to previous sports activity despite favourable physical records goes into rehabilitation with an insufficient mental plan. They usually lack a goal-setting plan and a positive attitude towards the rehabilitation<sup>56</sup>.

### *Locus of control*

Patients with an ACL injury, who regard their health status as being controlled by internal factors, have been shown to have a lower perceived functional deficit pre-operatively<sup>82</sup>. *Internal locus of control* refers to the patients’ belief that the outcome after injury or surgery is directly related to their individual behaviour. *External locus of control* refers to patients who believe that the outcome after injury or surgery is under the control of powerful others<sup>108</sup>. Patients may also believe that the outcome after injury or surgery is determined directly by fate, luck or chance, corresponding to Locus of control by chance<sup>108</sup>. Dissatisfied patients may have overly high or unrealistic expectations about the effects of surgery and they may not be mentally prepared for the post-surgical demands of rehabilitation<sup>1,37</sup>.

### *Coping strategies*

Patients with a knee injury, who use negative coping strategies for pain and report a poorer quality of life, have been shown to have an inferior result after rehabilitation and surgery<sup>56,82,104</sup>. Quantitative studies have indicated a tendency for negative emotions to decrease and positive emotions to increase over the course of rehabilitation<sup>36,73,85</sup>. Morrey and co-workers<sup>78</sup> have, however, documented a slight increase in negative emotions and a slight decrease in positive emotions at the end of a lengthy period of rehabilitation after knee surgery.

Athletes have cited fear of re-injury as a salient emotion associated with resuming sports participation<sup>23,57</sup>. According to Kvist and co-workers<sup>62</sup>, patients having undergone an ACL reconstruction, who did not return to their pre-injury level had more fear of re-injury.

Furthermore, psychological factors have been described as playing an important role in the recovery from sports injury<sup>25</sup>. Athletes who sustain a major sports injury experience marked feelings of anger, confusion, depression, fear and frustration early in rehabilitation<sup>23,57,107</sup>. The coping strategies that are used, perceived quality of life and the seriousness of the injury have all been shown to affect the self-efficacy beliefs, which are perhaps the most predictive of subsequent behaviour during rehabilitation<sup>33</sup>. The way the patient reacts emotionally to the ACL injury appears to have important implications not only for his/her subjective well-being but also for his/her rehabilitation behaviour and clinical outcome<sup>26,78</sup>.

### *Self-efficacy*

#### *The concept*

The social cognitive theory and concept of self-efficacy was introduced by Bandura<sup>16</sup> to explain the effects of self-referent thoughts (self-reflections) on psychosocial functioning. Self-efficacy refers to the way people judge their capabilities to organise and execute the courses of action required to attain designated types of performance<sup>16</sup>. In other words, people set themselves goals and they anticipate the likely outcome to guide and motivate their efforts. They are also the self-examiners of their own function (Figure 2).

Self-efficacy beliefs are said to influence not only the courses of action pursued but also the effort expended, endurance when facing difficulties, the nature of thought patterns and affective reactions<sup>16</sup>. In other words, if a person believes that an action can be taken to solve a problem, the person will become more inclined to take that action and also feel more committed to this decision.

According to Bandura<sup>13</sup>, self-efficacy makes a difference to the way people feel, think and act. Low sense of self-efficacy is associated with depression, anxiety, helplessness and pessimistic thoughts about personal accomplishment and development. Locke and co-workers<sup>69</sup> have suggested that people with high levels of self-efficacy select more difficult goals and, once selected, they have greater commitment to those goals. People with high self-efficacy also choose to perform more challenging tasks. When setbacks occur, they recover more quickly and maintain their commitment to their goals. Bandura<sup>14</sup> suggested that, when negative discrepancies are experienced between aspirations and actual achievement level, performers with high self-efficacy will increase their level of effort and persistence, whereas low self-efficacy performers will give up.



## Introduction

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High self-efficacy is not the same as positive illusions or unrealistic optimism, since self-efficacy is based on personal experience and does not lead to unreasonable risk-taking. Instead, high self-efficacy leads to behaviour which is within the reach of one's capabilities<sup>13</sup>. Furthermore, perceived self-efficacy is considered task specific and therefore different from one domain of functioning to another for particular situations, as well as for intellectual and social skills<sup>13</sup>.

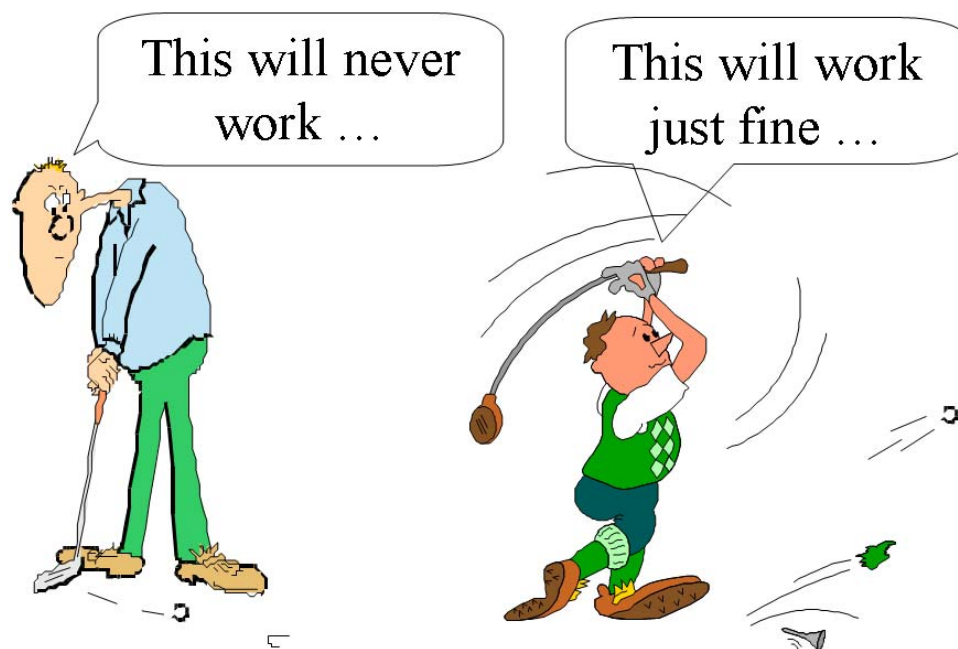


Figure 2 - Self-efficacy refers to the way people judge their capabilities to organise and execute the courses of action required to attain designated types of performance<sup>16</sup>. In other words, people set themselves goals and they anticipate the likely outcome to guide and motivate their efforts. They are also the self-examiners of their own function. If a person believes that an action can be taken to solve a problem, the person will become more inclined to take that action and also feel more committed to this decision.

### *Human involvement*

Self-efficacy for various tasks evolves through experience. People are formed through different experience and involvement in life. Bandura<sup>17</sup> suggests describing human involvement in four core features; *intentionality, forward-directed planning, self-reactions and self-reflections*. For the present thesis, the following descriptions (Figure 3) are used for these core features:

*Intentionality*: Represents what future course of action the person is intending to take and get involved in. Outcomes are not the characteristics of the involvement; they are more the consequences of them.

*Forward-directed planning*: People set goals for themselves and anticipate the likely consequences of their prospective actions. They select actions likely to produce desired outcomes and avoid detrimental ones.

*Self-reactions*: Action taken gives rise to self-reactions by comparing the performance with personal goals and standards. The self-reaction depends to a large extent on how far into the future the goals are projected and how well they can be realised.

*Self-reflections*: Through conscious self-reflection, people evaluate their motivation, values and the meaning of their life pursuits. They judge the correctness of their predictive and operative thinking against the outcome of their actions. It is on the basis of their self-efficacy beliefs that people choose which challenge to undertake.

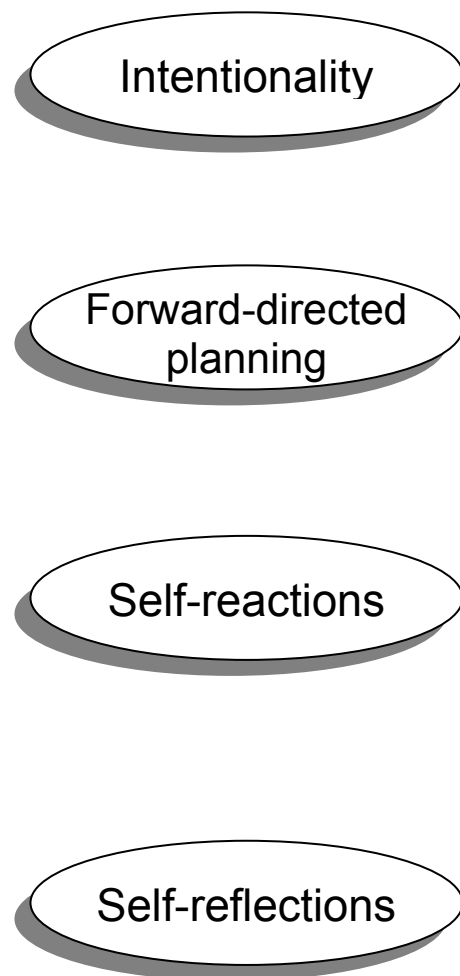


Figure 3 – The core features of human involvement suggested by Bandura<sup>17</sup>.

### *Implementations of self-efficacy*

In order to achieve desired health changes, an implementation model for ways of approaching people with different levels of self-management capabilities has been described by Bandura<sup>15</sup>. The model discusses individuals at three levels, as seen in Figure 4.

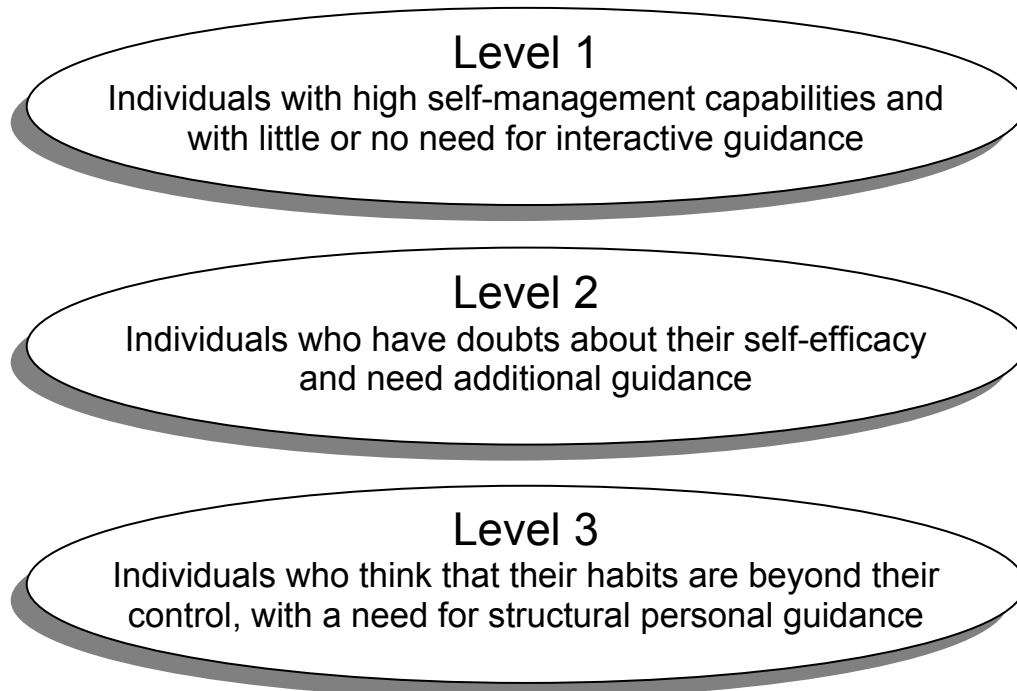


Figure 4 – People with three different levels of self-management capabilities<sup>15</sup>.

At the first level, the patients are supposed to have a high sense of self-efficacy, and positive outcome expectations and require minimal guidance to accomplish what they seek.

Individuals at the second level have doubts about their self-efficacy, as well as doubts about the benefits of their efforts. They give up easily when facing difficulties and their efforts are therefore not ultimate. They need additional support and guidance through interactive means from parents, friends, teammates, coaches, physical therapists and doctors.

At level three, patients believe that their well-being is out of their personal control. A patient at level three who has a low self-efficacy early in the rehabilitation process probably needs a great deal of personal guidance to make successful rehabilitation possible.

The implementation model could be applied in the rehabilitation of patients with an ACL injury. Many patients with an ACL injury will be at level one, as they are young, active and determined early in their rehabilitation process to return to their previous level of physical activity. Determinants of patient satisfaction with the outcome after reconstruction of the anterior cruciate ligament has been found to be the patients subjective assessment of symptoms and function<sup>60</sup>. Strategies to reinforce or to maintain high self-efficacy may as well be necessary in order for the patient to reach a satisfactory outcome.

### *Strategies to reinforce self-efficacy*

Bandura<sup>15</sup> has suggested that a sense of competence can be acquired by *mastery experience*, *social modelling* and *social persuasion* (Figure 5). The capacity is also thought to be dependent on one's present *physical and emotional state*<sup>15</sup>.

- The most effective way to acquire a sense of competence is considered to be through *mastery experience*. Being successful in overcoming difficulties strengthens one's efficacy, while failures undermine it.
- The second way of strengthening perceived self-efficacy can be achieved through *social modelling*. If people see others like themselves succeed by sustained effort, they may come to believe that they, too, have the capacity to succeed.
- *Social persuasion* is the third way to strengthen people's beliefs. If people are persuaded that they have what it takes to succeed, they exert more effort than if they have self-doubts. Effective social persuasion can do more than just strengthen faith in people's capabilities. Those who are effective in their social persuasion can arrange things in ways to bring success and avoid failure.
- People also appear to rely on their *physical and emotional state* to judge their capabilities. In activities that require strength and stamina, fatigue and pain may be interpreted as low self-efficacy for physical functioning. Tension, anxiety and depression may also be signs of personal deficiency<sup>15</sup>.

# Introduction

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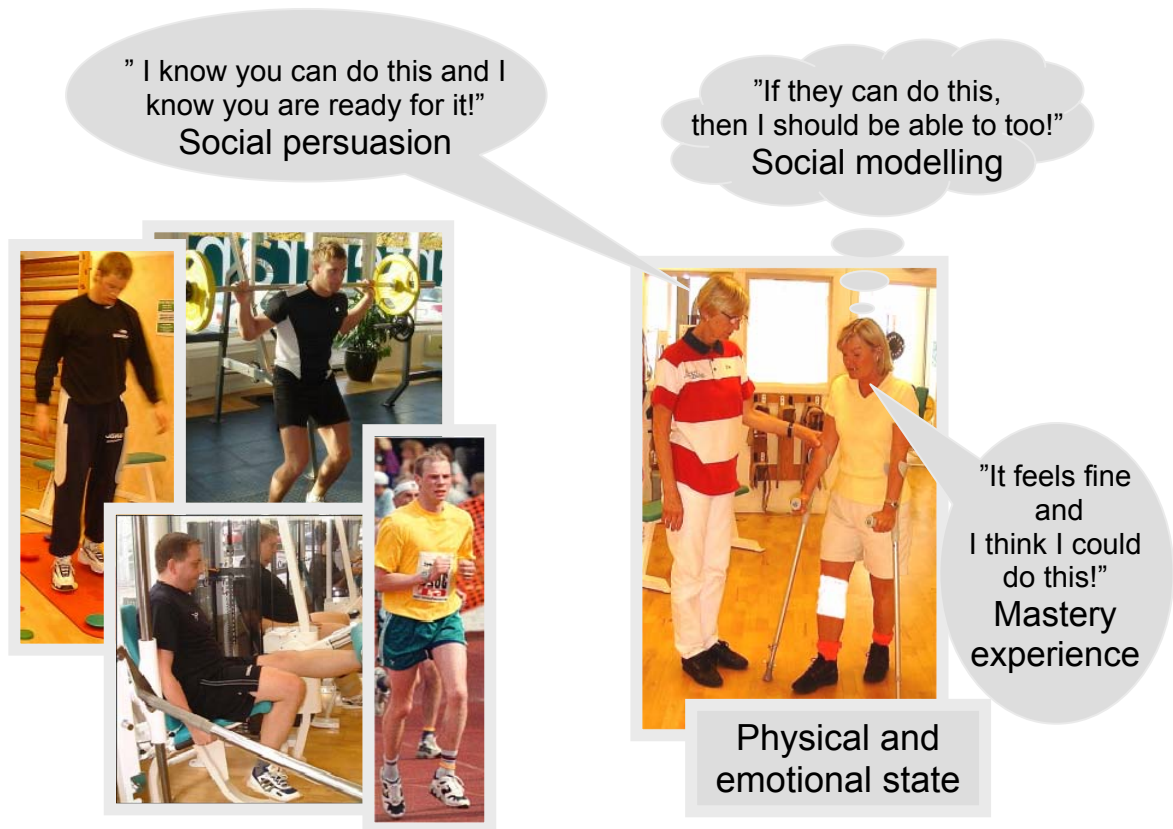


Figure 5 – The patient can acquire a sense of competence by mastery *experience*, *social modelling* and *social persuasion*<sup>15</sup>. The capacity is also thought to be dependent on one's present *physical and emotional state*<sup>15</sup>.

### *Self-efficacy and rehabilitation*

The significance of human involvement in terms of goal-setting and self-efficacy beliefs in patients with an ACL injury has been discussed by Evans and Hardy<sup>39</sup>. Goal-setting and the strengthening of self-efficacy beliefs were thought to be of major importance for successful rehabilitation after knee surgery. Expectations, as well as verbal and social persuasion by health professionals, appear to be important for perceived self-efficacy<sup>20,33</sup>. The patient's perceived self-efficacy thus appears to be an important factor in the rehabilitation after an ACL reconstruction, especially in terms of the outcome measured by physical participation, subjective knee function and quality of life<sup>33,40</sup>.

As is pointed out in the literature, when dealing with illnesses such as cardiac disease<sup>65</sup>, whiplash-associated disorders<sup>29,99</sup>, osteoarthritis<sup>70,76</sup> and chronic low back pain<sup>3</sup>, the focus should be on strengthening the patients' self-efficacy of performance and physical tasks during the rehabilitation process in order to minimise the consequences of that particular illness/injury. For patients with rheumatic disease and for patients with chronic pain, the concept of self-efficacy has been shown to be important in understanding the patients' psychological and physical functioning<sup>5,20</sup>.

There are a number of studies indicating the importance of well-defined, guided rehabilitation for a successful outcome<sup>9,22,63,77</sup>, although the importance of self-efficacy of knee function has not to our knowledge, been studied in patients with an ACL injury.

### *Summary of interesting areas*

In the literature, there are many suggestions relating to the importance of the patients' self-efficacy for a successful outcome after sports-related injuries. No specific instrument for measuring self-efficacy of knee function in patients with an ACL injury is, however, available.

Among patients who have undergone a seemingly successful rehabilitation and/or ACL reconstruction, there are a number of patients who are still unable to return to their previous level of physical activity.

Different reasons for this have been suggested; for example, the patients have insufficient mental plans, external health locus of control, overly high or unrealistic expectations, low perceived physical functioning and a low desire for physical activity.

Athletes who sustain a major sports injury, such as an ACL injury, have been described as experiencing marked feelings of anger, confusion, depression, fear and frustration in the early period of rehabilitation. Athletes have, furthermore, cited fear of re-injury as a salient emotion associated with resuming sports participation. Fear of re-injury or kinesiophobia may be a psychological obstacle to returning to sports activities after an ACL reconstruction.

Patients with a knee injury, who use negative coping strategies for pain and report a lower quality of life, have been shown to have an inferior result after rehabilitation and surgery.

Many of the above-mentioned factors for patients with an ACL injury are associated with the patients' perceived self-efficacy of knee function, which is the main focus of this thesis.

## **Aims of the studies**

The overall purpose of this thesis was to obtain knowledge about *perceived self-efficacy of knee function* in patients with an ACL injury.

The specific aims were:

- to develop a specific instrument to measure self-efficacy of knee function, the Knee Self-Efficacy Scale (K-SES), for patients with an ACL injury
- to evaluate the validity and reliability of the K-SES
- to evaluate the responsiveness of the K-SES, i.e. the ability of the instrument to detect clinically important and relevant changes during rehabilitation
- to describe self-efficacy of knee function for males and female patients, both old and young, and for highly to moderately physically active patients
- to describe factors that are important and have a major impact in determining the variance in patients' perceived self-efficacy of knee function after one year of rehabilitation after injury or surgery
- to describe the success rate for outcome one year after surgery and rehabilitation
- to explore patients' perceived self-efficacy of knee function as possible predictors of outcome one year after surgery and rehabilitation



# Patients and methods

## *Development of the studies over time*

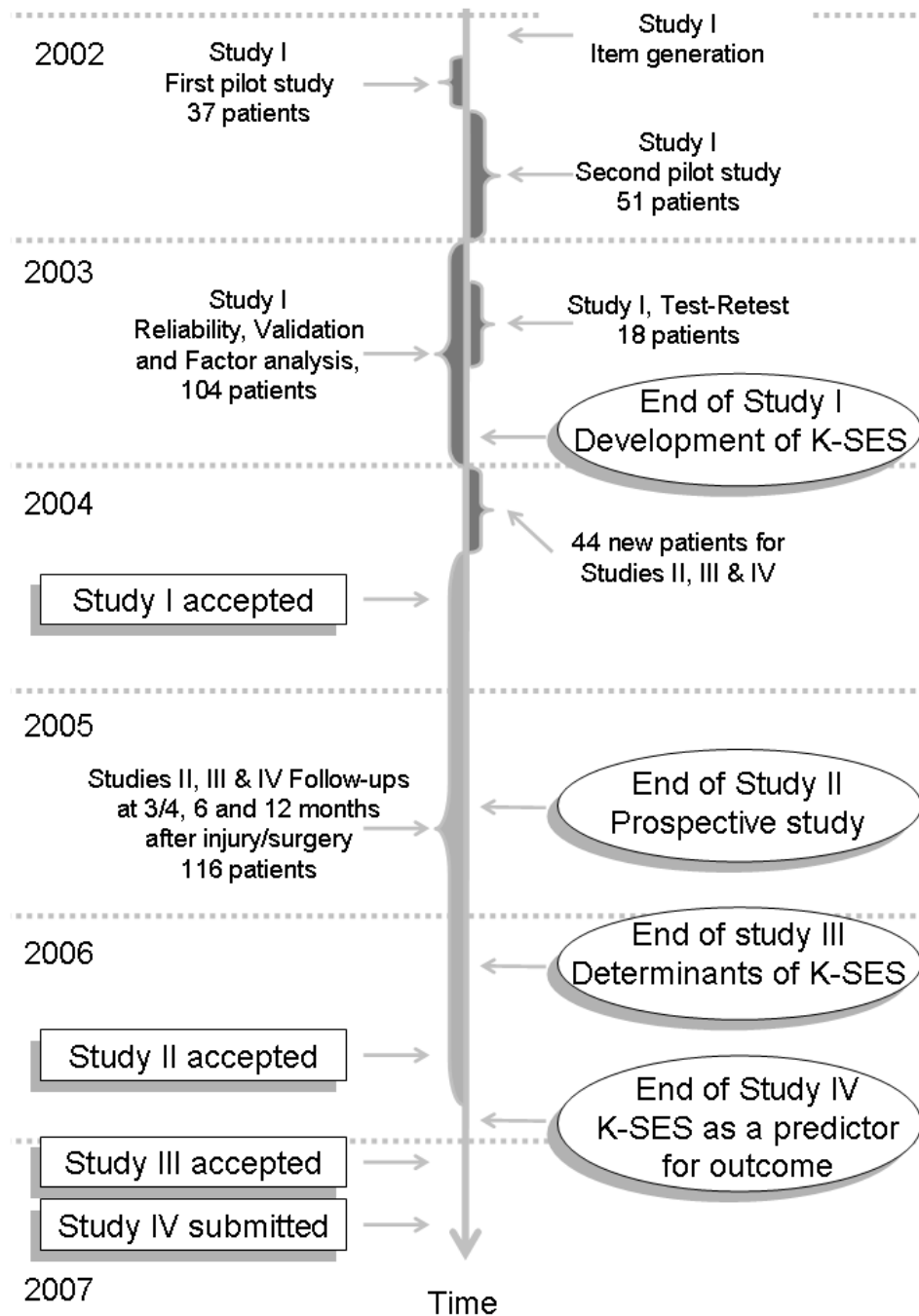


Figure 6 – The development of the four studies in this thesis between 2002 and 2007. The dark grey brackets indicate patient inclusion periods and the light grey bracket indicates the follow-up period.

### *Inclusion criteria*

Patients were included if they:

- had a suspected ACL injury (Studies I-III) based on history and a clinical examination performed by an experienced orthopaedic surgeon, or had undergone an ACL reconstruction (Studies I-IV)
- were between 16 and 60 years of age
- were injured during sports activity
- were able to read and understand the Swedish language

During the patient inclusion period approximately 95% of the patients with an ACL injury and ACL reconstruction, currently under rehabilitation at the Sportrehab - Physical Therapy & Sports Medicine Clinic, Göteborg, Sweden, were included if they fulfilled the inclusion criteria.

Recently ACL-injured patients were recruited from all the hospitals in the Göteborg area. Three patients who were subsequently diagnosed as not having an ACL injury were excluded.

Patients on the waiting list for an ACL reconstruction at Sahlgrenska University Hospital/Östra were recruited consecutively. Approximately 90% of the patients that could be reached were included.

***Distribution of patients***

A total of 255 patients were included in this thesis. The distribution of the patients included in the four studies is illustrated in Figure 7.

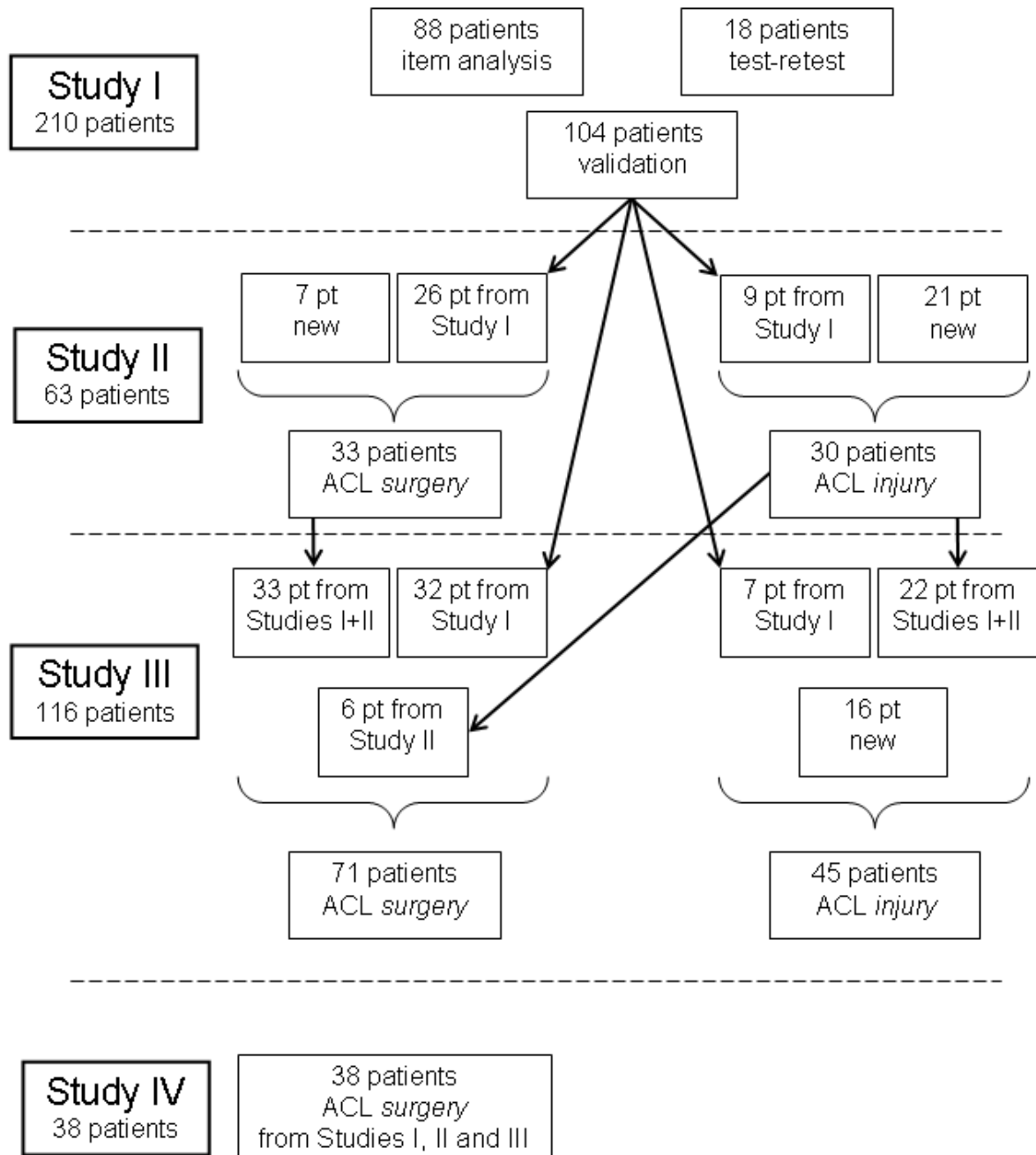


Figure 7 – Distribution of patients (pt) included in this thesis.

## Patients and methods

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### *Study I*

Descriptive statistics for the 210 male and female patients with an ACL injury who were involved in the various stages in Study I are presented in Table 1. In the first and second pilot study, the patients who were recruited were currently in rehabilitation, following an ACL injury or ACL reconstruction, at a sports medicine clinic. For the evaluation of K-SES (step 5, Table 1) 104 patients were recruited. The test-retest was conducted on 18 patients three months after ACL reconstruction.

Table 1 – Distribution, mean age and standard deviation (SD) for the 210 included patients.

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	Mean age ± SD
<b>Step 1 – Item generation</b>	
<b>Step 2 – Test construction</b>	
<b>Step 3 – First pilot study</b> (n=37, 18 w+19 m), (31 surg+6 non surg)	32.7±8.6
<b>Step 4 – Second pilot study</b> (n=51, 28 w+23 m), (35 surg+16 non surg)	32.1±10.1
<b>Step 5 – Evaluation of K-SES</b>	
<b>Internal consistency, validation and factor analysis</b> (n=104, 41 w+63 m), (64 surg+40 non-surg)	30.1±9.1
<b>Reliability test</b> (n=18, 4 w+14 m), (18 surg+0 non-surg)	27.2±7.0

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w = women, m = men

surg = patients who underwent ACL reconstruction

non-surg = patients with an ACL injury, not treated surgically

### *Study II*

Thirty patients were included for this one-year prospective study, 13 women and 17 men, with a mean age of 32.9 years (17-54), with an ACL injury (21 patients from Study I and 9 new patients included), and evaluated as recently injured and at all the subsequent follow-ups.

The study also included 33 available patients, 15 women and 18 men, with a mean age of 29.2 years (17-55), scheduled for ACL reconstruction (26 patients from Study I and 7 new patients included), and evaluated pre-operatively and at all the subsequent follow-ups.

The patients were recruited within a month after injury or within a month before scheduled surgery and they were rehabilitated for three to six months at a sports medicine clinic.

### *Study III*

A total of 116 patients, with a mean age of 31.2 years (18-55), were evaluated one year after injury/surgery. Forty-five patients (49% women) had a knee with an ACL injury and 71 patients (34% women) had undergone an ACL reconstruction. All patients were rehabilitated for three to six months at a sports medicine clinic. Seventy-one of the patients were recruited from Study I, 29 from Study II and 16 new patients were recruited for Study III.

### *Study IV*

All 38 patients with an ACL reconstruction from Study III, which had been evaluated pre-operatively, using the Knee Self-Efficacy Scale (K-SES) and evaluated at the one year follow up, were recruited for Study IV. All patients were tested within a month before scheduled surgery. Thirteen were women and 25 men, with a mean age of 29.7 years (16-55). All patients were scheduled for an ACL reconstruction within a month of the pre-operative evaluation. They were rehabilitated for three to six months, after surgery, at a sports medicine clinic. Twelve patients had an ACL reconstruction using a patellar tendon graft and 26 had an ACL reconstruction using a hamstring tendon graft. At the one year follow-up, patients were evaluated using outcome measures for present physical activity, knee symptoms and knee muscle function.

### *Rehabilitation protocol*

A vast majority of the patients in this thesis received rehabilitation training according to a standardised rehabilitation protocol at the Sportrehab - Physical Therapy & Sports Medicine Clinic, Göteborg, Sweden. The criterion based and goal oriented rehabilitation protocol is used for patients having an ACL injury and having undergone an ACL reconstruction. The various exercises are adjusted for each specific individual. The large variation that exists in for example cultural background, personality traits, previous physical activity level, if the knee is operated or not, the type of autograft used, the status of the patients knee, how the rehabilitation progress and the patients goals has a direct influence on how the physical therapist designs and gradually progress each individual specifically through the rehabilitation programme.

#### *Phase 1 - last approximately 1-2 weeks*

*Patient status:* Post ACL injury/reconstruction

*Goal:* Initiate an individual rehabilitation program

Give the patient information about his/her injury

Set-up a mutual goal for the rehabilitation

*Treatment program:* Exercises for daily rehabilitation

- Restore full knee extension
- Knee flexion till 90° or more
- Quadriceps/Hamstring control
- Reduce knee joint swelling
- Gait without crutches as soon as possible

#### *Phase 2 - last approximately 4-6 weeks*

*Patient status:* Reduced symptoms of knee joint swelling and pain

*Goal:* Full range of motion, normal gait pattern, increased motor control

Return to work with light strain on the knee

Improve the patient's understanding of his/her injury

*Treatment program:* Exercises for daily rehabilitation

- Range of motion training, bicycling allowed when 110° knee flexion is achieved
- Functional training, gait exercises forward, backward and sideways
- Coordination and balance exercises
- Pool exercises
- Pain free functional strength training, static and dynamic, open and closed chain exercises

### *Phase 3 - last approximately 8-16 weeks*

*Patient status:* Further reduced symptoms and increased knee joint tolerance

*Goal:* Return to work with heavy strain on the knee and light recreational sports

Reinforce stamina and muscle strength

Evaluate the goals together with the patient

*Treatment program:* Exercise program for all different qualities, 3-5 days/week

- Gradually increased strength training in open and closed chain
- Increased functional training like jogging, jumping, and sports-like exercises
- Gradually increased outdoor activities as a complement to rehabilitation, like biking and running, for a more general conditioning of the body

### *Phase 4 - last approximately 3-6 months*

*Patient status:* Minimal symptoms and increased knee joint tolerance to a gradually higher intensity of training

*Goal:* Gradual return to sports activities

Increase strength and stamina as tolerated

Evaluate the goals with the patient, if the goals are realistic or if they have to be revised

*Treatment program:* Exercise program that is gradually more sports specific

- Continue to increase strength training and activities for a more general conditioning of the body
- Continue to increase outdoor activities such as biking, running, skiing etc.
- Increase activities including cutting, twisting and, hopping for a gradual return to desired sports activity.

### *Design of the K-SES*

#### *Self-efficacy of knee function (K-SES)*

The Knee Self-Efficacy Scale (K-SES) was constructed to evaluate perceived self-efficacy of knee function<sup>106</sup>. The K-SES consists of 22 items divided into four sections A, B, C and D. For sections A; Daily activities (7 items), B; Sports activities (5 items) and C; Knee function tasks (6 items), the patients report how certain they are about performing the task right now, despite knee pain/discomfort. For section D; Knee function in the future (4 items), the patients report how certain they feel about their future capabilities. Patients gave their response to the 22 items on an 11-grade Likert scale ranging from 0 = not at all certain to 10 = very certain. The K-SES is a self-administrated instrument and it takes about 5 min for the patient to complete.

#### *Face validity*

To ensure good face validity of the items included in the K-SES, twelve physical therapists and two orthopaedic surgeons, all with experience of patients with an ACL injury, and two medical doctors experienced in evaluation and pain management took part in brainstorming sessions on the topic. Face validity was defined as a subjective judgment by experts in the field that items appeared to assess the desired qualities<sup>100</sup>.

#### *Content validity - Item generation*

For the item generation lists were drawn up of activities, situations and questions relating to what patients with an ACL injury were thought to be uncertain about doing. More items were generated from discussions between the health professionals and patients. This was done to establish good content validity, defined as a subjective judgment by experts in the field of whether the instrument samples relevant content or domains<sup>100</sup>. The item generation process resulted in more than one hundred items.

#### *Factor analysis*

During the process of item generation, the expert group categorised the items into four groups by identifying similarities such as: A) daily activities, B) sports/leisure activities, C) other physical activities and D) knee function in the future. These four groups of the K-SES are not identical to and should not be confused with the actual “loading” of the underlying factors described by the factor analysis. The two strong factors with an Eigenvalue of more than one generated by the factor analysis of the K-SES were designated as



“self-efficacy at present” and “self-efficacy in the future”. According to Streiner and Norman<sup>100</sup>, these two factors should be treated as two separate sub-scales. Our recommendation is that the total score for sections A, B, C and D of the K-SES should be used to evaluate the patients’ overall self-efficacy of knee function,  $K-SES_{ABCD}=K-SES_{Total}$ , the scores for sections A, B and C should be used to evaluate the patients’ present self-efficacy of knee function  $K-SES_{ABC}=K-SES_{Present}$ , and section D should be used to evaluate the patients’ future self-efficacy of knee function,  $K-SES_D=K-SES_{Future}$ .

### *The item analysis*

A careful item analysis was conducted by presenting the results as frequency histograms for each item in the first and second pilot study in Study I. The scores for the final 22 items chosen for the final K-SES were distributed throughout the entire spectrum, i.e. from low to high scores, as the property of a normal curve. According to Fhanér<sup>41</sup>, items with the property of a normal curve allow for the summation of all item scores and enable the sum to be divided by the number of items. Moreover, this allows for mean and standard deviation calculations of the score. In other words, it is possible to treat the score with parametric statistics for the specific population for which it is validated. The results from the K-SES in this thesis are presented with mean and standard deviation, but non-parametric statistics were used on the K-SES for correlations and comparisons between groups.

### *Reliability*

According to the literature<sup>41</sup>, *homogeneity* or “internal consistency” is the best test of reliability if the test only measures one trait or ability, as is the case with the K-SES. The test of homogeneity should not be perfect because the items should measure different aspects of self-efficacy of knee function. It is also important, however, that all items relate closely to the specific ability of self-efficacy of knee function. The K-SES presented good homogeneity, i.e. a Cronbach’s alpha of 0.94-0.78, for the four different parts of the K-SES.

For the *test-retest* reliability of the K-SES, 14 days between test days were chosen to limit the chance of patients remembering their previous scores. In two weeks of rehabilitation, it was, however, realised that too much improvement in skills in terms of function was possible and there were opportunities for the patients to test their ability and thereby change their self-efficacy of knee function. The test-rest reliability measurement produced an  $r_s = 0.73$  and an  $ICC = 0.75$  but with no significant differences between test days and this was regarded as an acceptable result.

### *Construct validity*

To test for construct validity, the extent to which a measure correlates with measures of other variables in ways that can be explained theoretically<sup>100</sup>, the K-SES was correlated with the Multidimensional Health Locus of Control (MHLC)<sup>108</sup> (a measure of people's beliefs that their health is or is not determined by their behaviour), the Coping Strategies Questionnaire (CSQ)<sup>91</sup> (a questionnaire that assesses eight different coping strategies for pain and two questions about how the patients feel about their perceived ability to reduce or control their pain) and the SF-36<sup>109</sup> (a quality of life instrument). Low correlation was found between the dimensions on the MHLC and the K-SES,  $r_s=-0.18-0.03$ , and between the coping strategies on the CSQ and the K-SES,  $r_s=-0.11-0.25$ . The correlation between the physical functioning dimension on the SF-36 and K-SES was  $r_s=0.8$  ( $p=0.01$ ), while it was  $r_s=-0.5-0.4$  between the K-SES and the rest of the dimensions on the SF-36.

### *Convergent validity*

To see how closely K-SES was related to an other measure of the same construct to which it should be related, i.e. to test for convergent validity<sup>100</sup>, the K-SES was correlated with the Knee Injury and Osteoarthritis Outcome Score (KOOS)<sup>88</sup> (a self-administered instrument for assessing function and symptoms after knee injury). The correlations between the K-SES and the sub-scales on the KOOS ranged from  $r_s=0.4-0.7$ .

### *Responsiveness*

Responsiveness is also known as sensitivity to change. It is the ability of a measure to detect a change when a change has occurred. Responsiveness was tested for the K-SES in *Study II*. There was a significant increase (change) in patients' perceived self-efficacy of knee function during rehabilitation correlated to the patients' increased physical activity, decreased perceived symptoms and increased function. K-SES was considered to have good responsiveness.

### *The K-SES score measurement characteristics*

According to “Psychological testing in theory and practice”<sup>41</sup>, most test psychologists are willing to accept the score and measurement characteristics of a given test, if an individual with a higher score shows more of that trait or ability that is being measured than an individual who obtains a lower score. It is, furthermore, recommended that the test only measures one trait or ability. The information should then be enough, according to Fhanér<sup>41</sup>, to compare a person with a high test score, on, for example, the K-SES, with a person who has a lower or equal score.

Good reliability and good face, content, construct and convergent validity were demonstrated for the K-SES for measuring perceived self-efficacy of knee function in patients with an ACL injury. The K-SES was found to be a valid and reliable self-administered instrument with good responsiveness for patients with an ACL injury<sup>105</sup>.

### *Evaluation methods*

#### *The Tegner activity grading scale (Tegner scale)*

The Tegner scale<sup>103</sup> is used for grading work and sport activities. It is numerically graded from 1 to 10. One represents the least strenuous knee activity and 10 is hard strenuous knee activity, such as rugby or international soccer. The Tegner scale was modified in 2000 (not yet published) and new sports such as floorball and snowboarding have been added to the score. The modified version was used in this study with the permission of the authors (Dr. Yelveton Tegner, personal communication).

In Study II, patients were defined as having returned to their baseline physical activity level if they reported a higher level, the same or one grade less on the Tegner scale at the 12-month test. In Study IV, patients were defined as having returned to their baseline physical activity level if they reported a higher level, the same or two grades less on the Tegner scale at the 12-month test.

#### *The Physical Activity Scale (PAS)*

The PAS was constructed by an expert group consisting of experienced physical therapists and orthopaedic surgeons, which assured good face validity for the scale<sup>105</sup>. The PAS scale originates from a validated score for middle-aged and former athletes as a model<sup>94</sup>. Patients were defined as having returned to their physical activity intensity and frequency of participation if they scored the same as the baseline PAS (Studies II and IV).

Subjects made their own assessment on the PAS of how vigorously and frequently they participated in physical activity at the present time and prior to their knee injury. The four grades on the PAS are:

1. Non-active, only sometimes going for a short walk or doing light work in the garden or similar
2. Light physical activity a few hours a week, such as taking a long walk, bicycling, dancing, normal gardening, or similar
3. More strenuous physical activity a few hours a week, such as playing tennis, swimming, running, workout, spinning, dancing, football, floorball, strenuous gardening, or similar
4. Hard strenuous physical activity during the week on a regular basis, with a demanding effort.

### *The Knee Injury and Osteoarthritis Outcome Score (KOOS)*

The KOOS is a self-administered instrument for assessing function, symptoms and associated problems for patients with a knee injury<sup>88</sup>. It consists of five subscales; pain, symptoms, function in daily living, function in sports and recreation and knee-related quality of life. The answer options are given using five Likert boxes. Each subscale is calculated separately and converted to a 0-100 score, where 0 indicates extreme symptoms and 100 indicates no symptoms.

### *Lysholm score*

The Lysholm score is a symptom-related knee score<sup>72</sup> assessed by the patients themselves in the present thesis. It measures eight symptoms and the specific disability for that symptom. The symptom severity is given a number from 0 to 25. These numbers are then summarised according to a scoring key into a score from 0 for someone who has all the symptoms and the worst disability to 100 for patients who have no symptoms or disability from their knee.

### *The Multidimensional Health Locus of Control (MHLC)*

The MHLC is a measure of people's beliefs that their health is or is not determined by their behaviour<sup>108</sup>.

*Internal health* locus of control – refers to the belief that one's outcome is directly related to one's own behaviour.

*External health* locus of control – refers to the belief that one's outcome after injury or surgery is under the control of powerful others.

*Health locus of control by chance* – refers to the belief that one's outcome is determined by fate, luck or chance.

The MHLC includes 18 items and the patients report their belief from zero "I do not agree at all" to six "I strongly agree". The score is summarised and divided by the number of items for each category into a mean for that particular category. The Swedish version of the MHLC was used with the permission of Professor Sven Carlsson (at the Institution of Psychology, University of Göteborg, Sweden) who did the translation and cross-cultural validation.

### *The Coping Strategies Questionnaire (CSQ)*

The CSQ, developed by Rosenstiel & Keefe<sup>91</sup>, is a questionnaire to assess coping strategies for pain. It is a self-administered instrument and the patients report on a scale from 0-6 how they cope with pain in different situations. Zero on the scale is “I never do or think like this” to six “I always do or think like this”. The CSQ consists of 50 items, summarised according to a scoring key to form seven cognitive coping strategies and two questions (a,b) about how the patients feel about their perceived ability to reduce or control their pain. A general description of each strategy is presented below.

1. *Diverting Attention*: the patient tries to think of something else.
2. *Reinterpreting Pain Sensations*: the patient thinks of the pain as something else (being another sensation outside the body).
3. *Coping Self Statement*: the patient tells him/herself that the pain is not bad and can be overcome.
4. *Ignoring Sensations*: the patient tells him/herself that there is no pain.
5. *Praying/hoping*: the patient tells him/herself that the pain will go away.
6. *Catastrophising*: the patient tells him/herself that the pain will never go away.
7. *Increase Behavioural Activities*: the patient engages in physical activities.
8.
  - a. *Control Pain*: the patients rate how much control over the pain they have.
  - b. *Decrease Pain*: the patients rate how able they are to decrease the pain.

The Swedish version of the CSQ was used in this study<sup>52</sup>.

### *The SF-36*

The SF-36 is a health-related quality of life instrument<sup>109</sup>. The SF-36 consists of 36 items, divided into eight dimensions: *Physical Functioning, Role-Physical, Bodily Pain, General Health, Vitality, Social Functioning, Role-Emotional and Mental Health*. The items are summarised into raw scores following an algorithm and then transformed into a 0 to 100 scale using a formula in the Swedish *manual and interpretation guide*<sup>102</sup>.

### *Prior experience of injury/illness*

Prior experience of serious injury/illness was based on patient self-reports and what they could recall. The definition of *serious* was any injury/illness that caused surgery and/or rehabilitation for more than two months. The subjects also considered if they had *no*, *good* or *bad* experience when resuming their prior physical activity.

*Good experience* = has resumed prior physical activity within six months and  
*bad experience* = has not resumed prior physical activity within six months from the injury/illness.

### *Test battery of muscle function*

A test battery of three lower-extremity muscular power tests<sup>81</sup> and a test battery of three hop tests<sup>46</sup> were performed by the patients. The test batteries have been found to be reliable and valid after ACL injury and ACL reconstruction<sup>81,46</sup>. The test batteries for muscular power consisted of two open-chain exercises, i.e. knee extension and knee flexion, and one closed-chain exercise for the lower extremities, i.e. leg press. For the test battery of hop performance, the subjects performed a one-leg counter-movement jump, a one-leg hop for distance and a 30-second one-leg side jump. For all the muscular function tests, a Lower limb Symmetry Index (LSI) was calculated to determine the side-to-side leg difference. The LSI was defined as the ratio between the involved limb score and the uninvolved limb score expressed in per cent (involved/uninvolved x 100 = LSI).

## Patients and methods

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### *Test schedule after ACL injury*

Patients with an ACL injury were evaluated within one month after the injury and four, six and 12 months after the ACL injury (Table 2).

Table 2 – The various methods and occasions used for evaluation in patients with an ACL injury.

<b>Methods</b>	<b>Months after ACL injury</b>			
	<b>0-1</b>	<b>4</b>	<b>6</b>	<b>12</b>
Self-efficacy (K-SES)	X	X	X	X
Coping (CSQ)		X		X
Locus (MHLC)	X		X	X
Quality of life SF-36	X			X
Knee symptoms (KOOS)		X		X
Lysholm score				X
Previous injuries/illnesses	X			X
Physical activity (Tegner & PAS)	X	X	X	X
Muscle function		X	X	X

### *Test schedule before and after ACL reconstruction*

Patients who had undergone ACL reconstruction were evaluated pre-operatively and three, six and 12 months after the ACL reconstruction (Table 3).

Table 3 – The various methods and occasions used for evaluation in patients who had undergone ACL reconstruction.

<b>Methods</b>	<b>pre-op</b>	<b>Months after ACL reconstruction</b>		
		<b>3</b>	<b>6</b>	<b>12</b>
Self-efficacy (K-SES)	X	X	X	X
Coping (CSQ)		X		X
Locus (MHLC)	X		X	X
Quality of life (SF-36)	X			X
Lysholm score				X
Knee symptoms (KOOS)		X		X
Previous injuries/illnesses	X			X
Physical activity (Tegner & PAS)	X	X	X	X
Muscle function	X		X	X



# Statistics

Statistical analysis in this thesis was performed using the Statistical Package for Social Sciences (SPSS, version 11.5 - 14.0 for Windows). Standard procedures were used for descriptive statistics. All correlation coefficients ( $r_s$ ) were calculated using Spearman's rank correlation. All significance tests were two-tailed and conducted at the 5% significance level.

**Study I.** The internal consistency was assessed by calculating the Cronbach's alpha coefficient<sup>32</sup>. Test-retest data were also evaluated using the intraclass correlation coefficient (ICC)<sup>97</sup>. To study differences within groups in the test-retest, Wilcoxon's signed-ranks test was used. A maximum likelihood factor analysis using Harris Kaiser's rotation method was applied to the K-SES, as well as an item analysis.

**Study II.** To study differences within groups the Wilcoxon's signed-ranks test was used. For comparison between two groups the Mann-Whitney U-test was used.

**Study III.** For the linear regression analysis, the K-SES score was transformed to normal scores by the transformation by Blom. All the univariate correlations between the K-SES and the independent measures with a p-value of  $< 0.05$  were used in a forward stepwise linear regression model.

**Study IV.** For the multiple regression analysis, the outcome scores were transformed to normal scores by a transformation by Blom. The  $\beta$ -value is the estimated change in the dependent variable for a one-unit increase in the predictor. The  $R^2$  value for the model indicates how much of the variation can be explained by all the predictors in the model. Multiple logistic regression analysis was used with the dichotomised outcome variables as dependent variables. The odds ratio given is the odds ratio for an acceptable outcome level for a one-unit increase in the predictor. Both the multiple regression analyses and the multiple logistic regression analyses were used in order to analyse the effect of the K-SES on the outcome variables adjusted for covariates pre-injury. The Mann-Whitney U-test was used for comparison of pre-operative K-SES between subjects with an acceptable level of outcome and subjects without an acceptable outcome after one year.

# **Ethics**

All the studies included in this thesis were approved by the Human Ethics Committee at Göteborg University, number S 297-03. All the patients received oral and written information about the purpose and procedure of the study and written informed consent was obtained.

## Study I

### *A new instrument for measuring self-efficacy in patients with an Anterior Cruciate Ligament injury*

#### *Purpose*

The purpose of this study was to develop a reliable, valid instrument for measuring perceived self-efficacy of knee function in patients with an ACL injury.

#### *Results*

The internal consistency of the final 22-item K-SES was 0.94 for the total test, as calculated with Cronbach's alpha. For the four K-SES categories, Cronbach's alpha was 0.94 for Daily activities, 0.91 for Sports activities, 0.92 for Knee function activities and 0.78 for Knee function in the future. The test-retest revealed a correlation of  $r_s = 0.73$  between test days and an ICC of 0.75. No significant differences between test days were found.

Low correlations were found between the dimensions on the MHLC and the K-SES,  $r_s = -0.18-0.03$ , and between the coping strategies on the CSQ and the K-SES,  $r_s = -0.11-0.25$ . The correlation between the physical function dimension on the SF-36 and K-SES was  $r_s = 0.8$  ( $p=0.01$ ), while an  $r_s = -0.5-0.4$  was found between the K-SES and the rest of the dimensions on the SF-36. The correlations between the K-SES and the sub-scales on the KOOS ranged from  $r_s = 0.4-0.7$  ( $p=0.01$ ). A maximum likelihood factor analysis with Harris Kaiser's rotation method was applied in the factor analysis. The factor analysis produced two factors of importance with an Eigenvalue over one. Factor one was related to how the patients perceived their present physical performance/function, while factor two was related to how the patients perceived the future physical performance/prognosis of their knee.

#### *Conclusion*

Good reliability and good face validity, as well as good content, construct and convergent validity, were demonstrated for the new instrument (K-SES) for measuring perceived self-efficacy of knee function in patients with an ACL injury. The K-SES can be recommended for studies designed to evaluate prognostic and outcome expectations of perceived self-efficacy of knee function in patients with an ACL injury.

## Study II

### *Self-efficacy, symptoms and physical activity in patients with an Anterior Cruciate Ligament injury: a prospective study*

#### *Purpose*

The aim of this prospective study was to describe the patients' perceived self-efficacy of knee function at various times after injury and surgery respectively and to correlate the score on the K-SES with the patients' subjective symptoms. The aim was also to describe the influence of gender, age and physical activity on the patients' perceived self-efficacy of knee function.

#### *Results*

The perceived self-efficacy of knee function changed significantly during the course of rehabilitation. For patients with an ACL injury, the K-SES scores increased significantly ( $p < 0.001$ ) from a mean of 3.9 in the test when "recently injured" to a mean of 6.8 in the test 12 months after injury. There was also a significant ( $p < 0.05$ ) increase between each test occasion up to six months after injury, but no significant changes were found between the six- and 12-month follow-ups. For patients who had undergone ACL reconstruction, the scores increased significantly ( $p < 0.001$ ) from a mean of 5.0 at the pre-operative test to a mean of 7.6 at the follow-up test at 12 months. There was also a significant ( $p < 0.05$ ) increase for the K-SES between each test occasion up to twelve months after surgery.

#### *Self-efficacy of knee function and age*

"Younger" patients, aged 17-29, with an ACL injury obtained significantly ( $p = 0.034$ ) higher scores on the K-SES in the test when "recently injured" compared with "older" patients, aged 30-54.

#### *Self-efficacy of knee function and gender*

Men obtained significantly ( $p = 0.013$ ) higher perceived self-efficacy scores on the K-SES in the pre-operative test compared with women.

## Summary of studies

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### *Self-efficacy of knee function and baseline physical activity*

Patients with a higher baseline physical activity level (Tegner 7-10) obtained significantly ( $p=0.005$ ) higher scores on the K-SES in the pre-operative test compared with patients with a lower baseline physical activity level (Tegner 3-6).

### *Physical activity level*

At the 12-month test, 15 of the 30 patients (50%) with an ACL injury and 15 of the 33 patients (46%) who had undergone ACL reconstruction had returned to a higher, the same or one level lower than their baseline physical activity level, as documented using the Tegner scale. The corresponding results for returning to activity intensity and frequency of participation as measured on the PAS were 16 of the 30 patients (53%) and 20 of the 33 patients (61%) respectively.

### *Knee symptoms*

For patients with an ACL injury, low to moderate correlations ( $r_s=0.21-0.56$ ) were found at the four-month test between the KOOS subscales and the K-SES. At the 12-month test, the correlations were moderate to strong ( $r_s=0.33-0.71$ ). For patients who had undergone ACL reconstruction, low correlations between the KOOS and the K-SES ( $r_s=-0.16-0.25$ ) were found at the three-month test. At the 12-month test, the correlations were moderate to strong ( $r_s=0.41-0.72$ ).

### *Conclusion*

The conclusion from the present study was that self-efficacy of knee function increased significantly during rehabilitation in patients with an ACL injury, as well as in patients who had undergone ACL reconstruction. The improvement in perceived self-efficacy could, however, only be partly explained by the improvement in subjective symptoms. Furthermore, a significant difference in self-efficacy of knee function was observed early in the rehabilitation process, between men and women, young and old, and patients with a low and high pre-injury physical activity level. It may therefore be important to reinforce the patients' self-efficacy early in the rehabilitation process for even better results when it comes to returning to prior physical activity.

## Study III

### *Determinants of self-efficacy in the rehabilitation of patients with an Anterior Cruciate Ligament injury*

#### *Purpose*

The purpose of this study was to explore physical and psychological measures believed to determine patients' perceived self-efficacy of knee function in the rehabilitation of patients with an anterior cruciate ligament (ACL) injury.

#### *Results*

For the 116 patients, the mean (SD) for the complete K-SES (K-SES<sub>Total</sub>) was 7.3 (1.9) and the scores ranged from 1.0 to 9.8. The mean (SD) for the K-SES<sub>Present</sub> was 7.1 (2.0), ranging from 0.7 to 9.8, while for the K-SES<sub>Future</sub> it was 7.8 (1.9), ranging from 1.3 to 10. The median and interquartile range for the K-SES are illustrated in Figure 8.

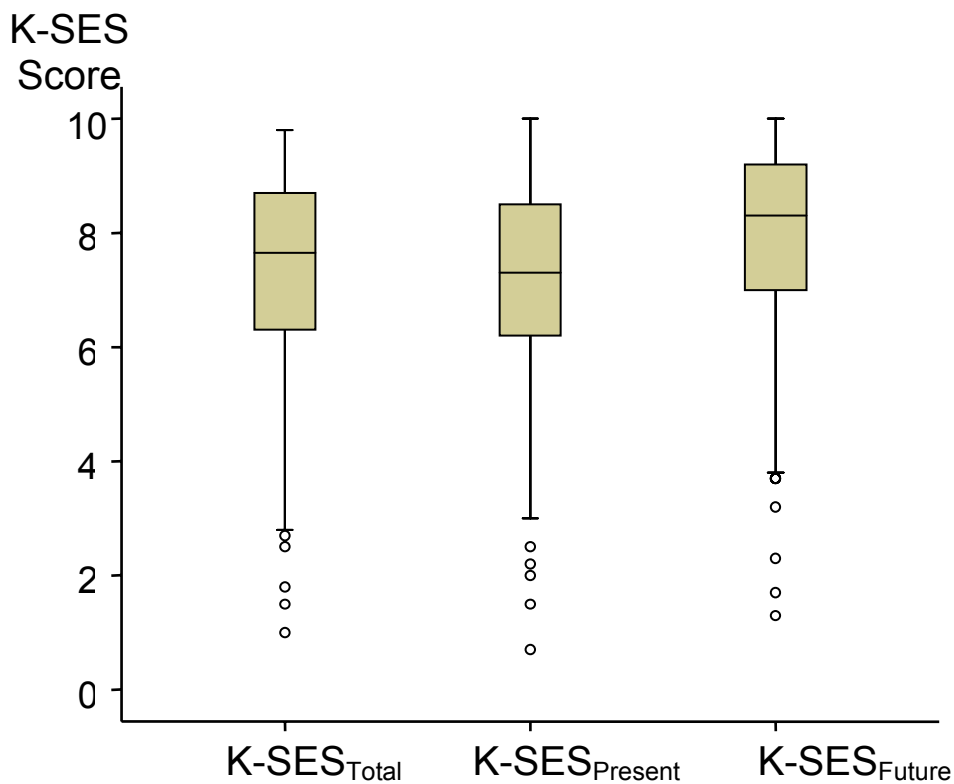


Figure 8 – Median, 5, 25, 75 and 95 percentiles and outliers (○) for the perceived self-efficacy of knee function (K-SES) for 116 patients one year after ACL injury/reconstruction.

## Summary of studies

The correlation coefficients between the K-SES and the independent measures are presented in Table 4.

Table 4 – Correlation coefficients (Spearman's  $r$ ) for the K-SES and all *the 39 independent measures*.

	K-SES		
	Total	Present	Future
<b>Personal factors</b>			
1 Gender	0.09	0.01	0.15
2 Surgery	0.13	0.10	0.20*
3 PAS <sub>Present</sub>	0.21*	0.19*	0.27**
3 Tegner <sub>Present</sub>	0.22*	0.18*	0.28**
5 Age	-0.08	0.03	-0.13
<b>SF-36</b>			
6 Physical Functioning	0.11	0.10	0.12
7 Role-Physical	0.07	0.06	0.07
8 Bodily Pain	-0.12	-0.15	-0.09
9 General Health	-0.05	-0.03	0.00
10 Vitality	0.06	0.07	0.03
11 Social Functioning	0.12	0.18	0.05
12 Role-Emotional	-0.08	-0.08	-0.04
13 Mental Health	0.11	0.11	0.10
<b>CSQ</b>			
14 Diverting Attention	-0.01	0.03	-0.05
15 Reinterpreting Pain	0.08	0.08	0.10
16 Coping	0.07	0.06	0.09
17 Ignoring	0.22*	0.19*	0.22*
18 Praying	-0.10	-0.05	-0.08
19 Catastrophising	-0.03	-0.01	-0.03
20 In Behaviour	0.05	0.08	0.04
21 Controlling Pain	0.19*	0.21*	0.22*
22 Decreasing Pain	0.24*	0.31**	0.15
<b>MHLC</b>			
23 Internal Locus Control	0.31**	0.32**	0.30**
24 External Locus Control	-0.13	-0.09	-0.11
25 Locus Control Chance	-0.19*	-0.22*	-0.12
<b>Previous experience factors</b>			
26 Injury <sub>Previous</sub>	0.01	-0.07	0.03
27 Illness <sub>Previous</sub>	-0.05	-0.03	-0.06
28 Injury <sub>Experience</sub>	0.01	0.09	-0.03
29 Illness <sub>Experience</sub>	0.02	0.00	0.04
30 PAS <sub>Pre-injury</sub>	-0.03	-0.04	0.00
31 Tegner <sub>Pre-injury</sub>	0.11	0.05	0.15
<b>Symptom and function factors</b>			
33 PAS <sub>Resumed</sub>	0.28**	0.29**	0.24**
32 Tegner <sub>Resumed</sub>	0.12	0.14	0.13
34 KOOS <sub>Symptoms</sub>	0.26**	0.29**	0.25**
35 KOOS <sub>Pain</sub>	0.25**	0.27**	0.22*
36 KOOS <sub>Adl</sub>	0.30**	0.29**	0.29**
37 KOOS <sub>Sports/Recreation</sub>	0.45**	0.46**	0.43**
38 KOOS <sub>QoL</sub>	0.39**	0.39**	0.38**
39 Lysholm score	0.51**	0.52**	0.50**

\* Significant  $p < 0.05$

\*\* Significant  $p < 0.01$

### *The stepwise linear regression*

The results of the stepwise linear regression analysis for the K-SES are presented in Table 5. The most important determinant found in the present study was the Lysholm score for symptom and function, as well as the way the patients perceived their sports and recreational function (KOOS<sub>Sports/Recreation</sub>). The most important *personal factor* for determining self-efficacy was Internal Locus of Control. A model using the Lysholm score, KOOS<sub>Sports/Recreation</sub>, Internal Locus of Control and Locus of Control by Chance explained 40% of the variance in the complete K-SES. For present self-efficacy of knee function (K-SES<sub>Present</sub>), a model of the Lysholm score, KOOS<sub>Sports/Recreation</sub>, Internal Locus of Control and Locus of Control by Chance explained 41% of the variance. For future perceived self-efficacy of knee function (K-SES<sub>Future</sub>), a model of the Lysholm score, KOOS<sub>Sports/Recreation</sub>, Tegner<sub>Present</sub> level and Internal Locus of Control explained 38% of the variance.

To ensure that no other dimensions on the KOOS were excluded due to collinearity with the Lysholm score, an additional stepwise regression was performed without the Lysholm score. No additional dimensions on the KOOS were, however, included by the stepwise regression model. Excluding the Lysholm score from the model resulted in 30% of the variance in the complete K-SES being explained by KOOS<sub>Sports/Recreation</sub>, together with Internal Locus of Control and Locus of control by chance.



## Summary of studies

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Table 5 – Forward stepwise linear regression for the K-SES

<b>K-SES<sub>Total</sub></b>	<b>Adj R<sup>2</sup></b>	<b>Beta</b>	<b>p-value</b>
Lysholm score	0.258	0.348	0.000
KOOS <sub>Sports/Recreation</sub>	0.345	0.305	0.000
Internal Locus of Control	0.374	0.181	0.018
Locus of Control by Chance	0.395	-0.161	0.032
<b>K-SES<sub>Present</sub></b>			
Lysholm score	0.270	0.350	0.000
KOOS <sub>Sports/Recreation</sub>	0.357	0.304	0.000
Internal Locus of Control	0.389	0.186	0.014
Locus of Control by Chance	0.412	-0.166	0.025
<b>K-SES<sub>Future</sub></b>			
Lysholm Score	0.265	0.335	0.000
KOOS <sub>Sports/Recreation</sub>	0.332	0.290	0.001
Tegner <sub>Present</sub>	0.360	0.167	0.032
Internal Locus of Control	0.377	0.155	0.047
<b>K-SES<sub>Total</sub> without the Lysholm score</b>			
KOOS <sub>Sports/Recreation</sub>	0.231	0.441	0.000
Internal Locus of Control	0.281	0.230	0.005
Locus of Control by Chance	0.300	-0.158	0.049

### *Conclusion*

The present study demonstrates that the K-SES was closely related to self-reported symptoms and functions, as well as to internal locus of control. The single most important determinant of self-efficacy of knee function in patients with an ACL injury was how the patient felt about his/her knee function in sports and recreational activities.

## Study IV

### *Self-efficacy of knee function as a pre-operative predictor of outcome one year after Anterior Cruciate Ligament reconstruction*

#### *Purpose*

The purpose of this study was to explore the potential for self-efficacy of knee function measured by the K-SES to predict patient outcome in terms of physical activity, knee symptoms and muscle function one year after an ACL reconstruction.

#### *Results*

The patients' pre-injury physical activity level was 7.6 (3-10) on the Tegner scale. Pre-operatively, the patients had a mean ( $\pm$ SD) for the K-SES<sub>Present</sub> of  $5.6 \pm 2.3$  and, for the K-SES<sub>Future</sub>, of  $5.9 \pm 2.2$ . The bivariate correlations between the possible predictors, K-SES<sub>Present</sub> and K-SES<sub>Future</sub>, with the scores on the outcome measures are presented in Table 6.

Table 6 – Spearman's correlation between the pre-operative K-SES and outcome measures at the one-year follow-up.

One-year outcome	Self-efficacy K-SES			
	present		future	
	$r_s$	p	$r_s$	p
<b>Physical activity</b>				
1. Tegner <sub>Present</sub>	0.37 *	0.03	0.10	0.56
2. PAS <sub>Present</sub>	0.32	0.20	0.01	0.76
<b>Symptoms</b>				
3. Lysholm score	0.09	0.58	0.30	0.07
4. KOOS <sub>Sports/Rec</sub>	0.17	0.32	0.45 **	0.00
5. KOOS <sub>Qol</sub>	0.01	0.96	0.48 **	0.00
<b>Muscle function</b>				
6. Knee ext	0.05	0.76	0.11	0.53
7. Knee flex	0.14	0.42	-0.01	0.94
8. Leg press	0.09	0.62	0.00	0.98
9. CMJ	0.33	0.06	0.12	0.50
10. Hop for dist	0.00	0.10	0.21	0.25
11. Side hop	0.23	0.21	0.29	0.11

\* Significant p < 0.05 difference

\*\* Significant p < 0.01 difference

## Summary of studies

One year after the ACL reconstruction, 59% to 60% of the patients had reached an acceptable level of physical activity, 37% to 71% of the patients had reached an acceptable level of perceived symptoms and 44% to 84% of the patients had reached an acceptable level of muscle function. The number and percentage of patients *reaching an acceptable level of each of the outcome variables* are presented in Table 7.

Table 7 – Patients with an acceptable/not acceptable level of outcome at the one-year follow-up.

One year Outcome	SR n (%)	Description of acceptable level	Pre-operative Self-efficacy K-SES		p	
			present Mean±SD (95%CI)	future Mean±SD (95% CI)		
<b>Physical activity</b>						
1. Tegner <sub>Present</sub>	acc not acc	22 (59%) 15 (41%)	≥ two levels lower than Tegner <sub>Pre-injury</sub>	6.0±2.1 (4.0-6.9) 5.0±2.6 (3.5-6.5)	6.4±2.2 (5.4-7.4) 5.5±2.3 (4.2-6.7)	
2. PAS <sub>Present</sub>	acc not acc	21 (60%) 14 (40%)	same level as PAS <sub>Pre-injury</sub>	5.6±2.2 (4.9-6.9) 5.4±2.4 (3.8-6.7)	6.5±2.4 (5.1-7.4) 5.7±2.0 (4.4-6.9)	
<b>Symptoms</b>						
3. Lysholm score	acc not acc	27 (71%) 11 (29%)	84-100	5.7±2.5 (4.8-6.7) 5.2±1.6 (3.7-6.5)	6.9±2.2 (5.7-7.4) 4.8±1.9 (3.3-5.8)	0.003
4. KOOS <sub>Sports/Rec</sub>	acc not acc	16 (42%) 22 (58%)	76-100	5.7±2.5 (4.8-6.7) 5.1±1.5 (4.0-6.6)	6.8±2.4 (5.7-7.5) 5.0±1.5 (3.6-5.6)	0.002
5. KOOS <sub>QoL</sub>	acc not acc	14 (37%) 24 (63%)	76-100	5.8±2.3 (4.4-7.0) 5.3±2.2 (4.5-6.5)	6.9±2.6 (5.4-8.2) 5.8±1.9 (4.7-6.3)	0.037
<b>Muscle function</b>						
6. Knee extension	acc not acc	16 (47%) 18 (53%)	≥ 90% of uniniv. leg	5.4±2.4 (4.0-6.6) 5.6±2.1 (4.7-6.8)	6.5±2.0 (5.3-7.3) 6.1±2.5 (4.8-7.3)	
7. Knee flexion	acc not acc	25 (74%) 9 (26%)	≥ 90% of uniniv. leg	6.1±1.9 (5.1-6.7) 4.0±2.4 (2.4-6.5)	6.2±2.4 (5.3-7.1) 6.2±2.0 (4.7-7.6)	
8. Leg press	acc not acc	26 (76%) 8 (24%)	≥ 90% of uniniv. leg	5.6±2.2 (4.7-6.5) 5.4±2.3 (3.4-7.3)	6.4±2.4 (5.4-7.2) 5.8±2.0 (4.1-7.4)	
9. CMJ	acc not acc	14 (44%) 18 (56%)	≥ 90% of uniniv. leg	5.8±2.0 (4.8-7.1) 5.4±2.4 (4.0-6.4)	6.3±2.0 (5.0-7.3) 6.2±2.5 (5.0-7.4)	
10. Hop for dist	acc not acc	27 (84%) 5 (16%)	≥ 90% of uniniv. leg	5.7±2.3 (4.7-6.6) 4.8±1.8 (2.6-7.0)	6.7±2.0 (5.8-7.4) 4.0±2.5 (1.0-7.0)	0.040
11. Side hop	acc not acc	18 (56%) 14 (44%)	≥ 90% of uniniv. leg	5.9±2.5 (4.8-7.3) 5.0±1.7 (3.9-5.8)	7.0±2.0 (5.9-7.9) 5.2±2.3 (4.0-6.6)	

SR – “success” rate – number and percent of patients having an acceptable/ not acceptable level of outcome.  
p – p-value, Mann Whitney U test, for difference on pre-operative K-SES<sub>Future</sub> between patients on acceptable and not acceptable levels of outcome

## Summary of studies

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*Physical activity.* A multiple regression analysis revealed that K-SES<sub>Present</sub> was a significant ( $p=0.047$ ,  $\beta=0.13$ ) predictor of Tegner<sub>Present</sub> at the one-year follow-up when adjusted for age and gender ( $R^2=0.11$ ). K-SES<sub>Present</sub> was also a significant predictor ( $p=0.016$ ) of PAS<sub>Present</sub> at the one-year follow-up when adjusted for age, gender and Tegner<sub>Pre-injury</sub> (odds ratio=2.1, 95% CI=1.2-3.9) using a multiple logistic regression analysis.

*Symptoms.* A multiple regression analysis revealed that the pre-operative K-SES<sub>Future</sub> was a significant ( $p=0.045$ ,  $\beta=2.56$ ) predictor of KOOS<sub>Sports/Recreation</sub> at the one-year follow-up when adjusted for age, gender and Tegner<sub>Pre-injury</sub> ( $R^2=0.25$ ). The pre-operative K-SES<sub>Future</sub> was also a significant ( $p=0.023$ ,  $\beta=2.96$ ) predictor of KOOS<sub>QoL</sub> at the one-year follow-up when adjusted for age, gender and Tegner<sub>Pre-injury</sub> ( $R^2=0.23$ ).

*Muscle function.* A multiple logistic regression, adjusted for age, gender and Tegner<sub>Pre-injury</sub>, produced an odds ratio between K-SES<sub>Future</sub> and the acceptable level of hop for distance of 2.2 (95% CI = 1.0-5.1).

### *Conclusion*

In conclusion, this study indicates that patients' perceived self-efficacy of knee function pre-operatively is of predictive value for their return to acceptable levels of physical activity, symptoms and muscle function one year after ACL reconstruction.

# Discussion

### *General*

No instruments for evaluating perceived self-efficacy of knee function in patients with a knee injury were found in the literature. After careful consideration, the challenge of constructing such an instrument was undertaken. The knee self-efficacy scale (K-SES) was developed to evaluate patients' perceived self-efficacy of knee function during rehabilitation, specifically for patients with an ACL injury. It has now been validated for patients with an ACL-deficient knee, as well as for patients who have undergone an ACL reconstruction. It may be possible to use the K-SES for patients with other knee injuries, but the K-SES must first be validated for that specific group of patients. In the present thesis, only patients with an ACL injury and patients who had undergone an ACL reconstruction were studied.

### *Patients*

Two hundred and ten patients were recruited for the construction and validation of the K-SES. In order to achieve good generalisability of perceived self-efficacy of knee function during rehabilitation, a heterogeneous group of ACL-deficient and ACL-reconstructed patients, i.e. a group of men and women who were young (16-35 years old), middle aged (36-55 years old) and with a large span of physical activity level (3-10 on the Tegner activity scale) were tested. Furthermore, patients were also tested during the entire spectrum from recently injured, with a suspected ACL injury, to one year after ACL reconstruction. The number of patients in *Study I* and *Study III* was sufficient to draw specific conclusions. In the prospective studies in *Study II* and *Study IV*, a larger sample size would have been preferable in order to draw more definite conclusions.

### *Procedures*

The various methods and occasions used for evaluation were chosen from a practical and strategic standpoint to achieve the best adherence. The procedure was time consuming, taking an hour to an hour and a half on each test occasion. Patients had to come to the laboratory twice in order to complete all the tests, preferably within one or two weeks. A few patients dropped out because of the time-consuming procedure of completing all forms and performing all muscle function tests. The completion of the K-SES, however, only took a few minutes.

### *Considerations on the construction of the K-SES*

A group of clinicians, experienced in the field of knee function and pain, were engaged in the construction of this domain-specific instrument for self-efficacy relating to the perceived level of knee function for patients with an ACL injury. The methods used for the construction and validation of the Knee Self-Efficacy Scale (K-SES), are described in detail in *Study I and II*. Some important issues from the construction process that need to be discussed are construct validity and measurement of change.

### *Construct validity*

Construct validity, the extent to which a measure correlates with measures of other variables in ways that can be explained theoretically<sup>100</sup>, was based on the expert group's identification of factors believed to determine perceived self-efficacy of knee function in patients with an ACL injury, as well as what was described in the literature for the concept of self-efficacy<sup>16</sup>. The literature discusses self-efficacy in relation to the patients' coping strategies, locus of control, health-related quality of life and the patients' interpretation of symptoms and function. The K-SES was supposed to identify the patients' perceived self-efficacy of knee function and should not be too similar to the way patients cope with the situation, locus of control, health-related quality of life and the interpretation of symptoms or function. The aim of the K-SES was to identify a new quality, the self-efficacy of knee function, which is believed to play an important part in rehabilitation. Figure 9 illustrates three different possible relationships between the K-SES and the other instruments used in this thesis: coping strategies (CSQ), locus of control (MHLC), health-related quality of life (SF-36) and the patients' interpretation of symptoms and function (KOOS). In Figure 9a, the K-SES is not actually a unique quality, but is instead almost completely described by all the other studied measures. In this case, the K-SES would not be worth studying. In Figure 9b, the K-SES is partly correlated to a greater or lesser extent to the other measures. In this case, the K-SES would have its own unique quality and would therefore have the potential to play an important part in the rehabilitation. In Figure 9c, the K-SES is not correlated to any other measure and can therefore not be explained at all. The K-SES would have its own unique quality but would not have anything to do with how patients cope with the situation, their locus of control, their health-related quality of life and their interpretation of symptoms or function. The K-SES would then not make sense of what it was designed to measure.

## Discussion

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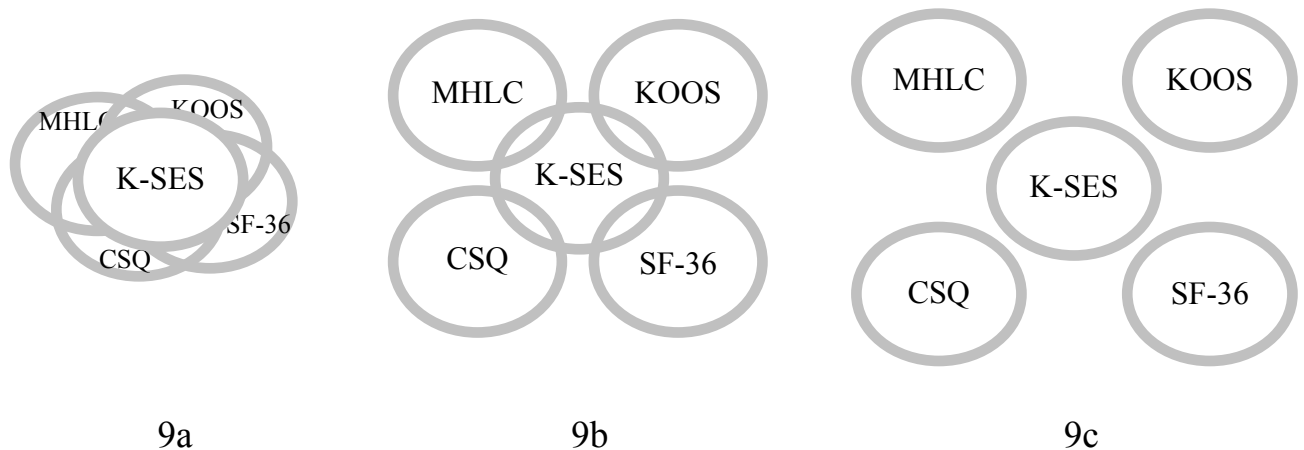


Figure 9 – Illustration of three possible relationships between the K-SES and instruments for related abilities discussed in the literature. Relationship (b) was the preferable situation and this was confirmed to be the case in the present thesis. In Figure 9a, the K-SES is not actually a unique quality, but is instead almost completely described by all the other studied measures. In this case, the K-SES would not be worth studying. In Figure 9b, the K-SES is partly correlated to a greater or lesser extent to the other measures. In this case, the K-SES would have its own unique quality and would therefore have the potential to play an important part in the rehabilitation. In Figure 9c, the K-SES is not correlated to any other measure and can therefore not be explained at all. The K-SES would have its own unique quality but would not have anything to do with how patients cope with the situation, their locus of control, their health-related quality of life and their interpretation of symptoms or function. The K-SES would then not make sense of what it was designed to measure.

According to Streiner and Norman<sup>100</sup>, the important questions in the validation of an instrument are “Does the hypothesis of this validation study make sense in the light of what the scale is designed to measure?” and “Do the results of this study allow one to draw the inferences one wishes to make?”. The hypothesis was that the K-SES could be partly explained by the scores it was validated against (as illustrated in figure 9b). The construct of self-efficacy in the K-SES was confirmed in *Study I* to be partly and significantly explained by physical functioning on the SF-36, as well as the patients’ interpretation of knee symptoms and function in sports and the patients’ knee quality of life on the KOOS. The coping strategies as measured with the CSQ, as well as health locus of control as measured by the MHLC, were of minor importance for the construction of the K-SES. It was noteworthy that, in *Study III*, internal locus of control, together with KOOS<sub>Sports/Recreation</sub> and Lysholm score were significant determinants of the K-

## Discussion

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SES one year after injury/surgery. In other words a high internal locus of control appears, however, to be important for a high self-efficacy of knee function after rehabilitation (see further discussion on determinants associated with self-efficacy).

### *Measurement of change*

According to Streiner and Norman<sup>100</sup>, the *measurement of change* has been a topic of considerable confusion in the medical literature. As a clinician and researcher, the ultimate goal of clinical research is to detect any change in the patients' condition. Instruments which are responsive to changes in health status are regarded as more sensitive measures of the effect of the clinical interventions than those that simply assess health status after an intervention.

Measurement of change can be directed at different goals, according to Linn and Slinde<sup>68</sup>. The goal in *Study II* was to *measure differences between individuals in the amount of change*, the first goal described by Linn and Slinde<sup>68</sup>. The intention was to identify and describe those individuals who changed considerably and those who did not change very much during rehabilitation. In *Study II*, there was no self-efficacy intervention other than structural interactive guidance according to the rehabilitation protocol, (see page 38-39) during the physical therapy and rehabilitation training. Needless to say, there was also a natural recovery over time, while the patients experienced improved function. Responsiveness is the ability of an instrument or measure prospectively to detect clinically important changes. During the one-year study of rehabilitation, a clinically important change was found for knee symptoms/function assessed by the KOOS between the three-to four-month and the 12-month follow-ups. Self-efficacy of knee function, as measured by the K-SES during the one-year study, was increased as well, indicating good responsiveness by the K-SES to this clinically important change.

The intention in the future is to apply the K-SES to the third goal described by Linn and Slinde<sup>68</sup>, *to infer treatment effects from group differences*, which is the primary goal of most clinical trials. Currently, our research group is involved in a study of patients with a recently injured ACL. Patients are randomly assigned to either a treatment group, in which the therapist actively uses the results from the K-SES and the available strategies to reinforce the patients' self-efficacy of knee function during rehabilitation, or to a control group. The third and final goal described by Linn and Slinde<sup>68</sup> may be fulfilled by this new randomised, prospective study.



### *Clinical considerations about self-efficacy in rehabilitation*

#### *Determinants associated with self-efficacy*

Self-efficacy is thought to make a difference to the way people feel, think and act<sup>13</sup>. The literature also discusses the action individuals take when considering previous experience, coping strategies, motivation, goal setting, locus of control and health-related quality of life, as well as the interpretation of function in relation to self-efficacy<sup>6,12,18,27,75,79,86,93,95</sup>.

There are, without any doubt, many factors that affect self-efficacy of knee function. In *Study II*, there was a significant increase in self-efficacy of knee function during the course of rehabilitation. This could be explained by the fact that the patients took effective action during the rehabilitation and made good progress with their knee function abilities and that their knee symptoms decreased. The patients therefore ended up with an improved self-efficacy of knee function. In *Study III*, approximately 40% of the variance in the K-SES was significantly explained by only a few of the determinants that were investigated, such as patients' perceived symptoms, function in Sports/recreation and internal locus of control. The patient's interpretation of knee symptoms, especially for sports and recreation, as well as his/her belief that the outcome is directly related to the rehabilitation behaviour, therefore appears to result in an acceptable outcome, with a higher perceived self-efficacy of knee function.

#### *Trait versus state*

Self-efficacy is considered to be a *state*, i.e. the way a person interprets the situation at a given moment in time. It is considered possible to influence and change a person's psychological *state*. It therefore appears to be reasonable to believe that using strategies to reinforce self-efficacy of knee function in patients with an ACL injury during rehabilitation may improve the outcome of rehabilitation. Even though self-efficacy of knee function is regarded as a *state*, there might also be some element of *trait* involved, i.e. a personality characteristic. A person's psychological *trait* is considered to be much more difficult to influence and change, and has not been addressed in the present studies.

The factor analysis in the K-SES identified the two strong factors around which the items clustered as perceived present self-efficacy of knee function, K-SES<sub>Present</sub>, and perceived self-efficacy of knee function in the future, K-

## Discussion

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SES<sub>Future</sub>. K-SES<sub>Present</sub> appears to be a *state* of self-efficacy, which is possible to influence and may change during rehabilitation, as presented in *Study II*. The second factor of the K-SES, perceived self-efficacy of knee function in the future, K-SES<sub>Future</sub>, appears not to be as easily influenced during rehabilitation. The K-SES<sub>Future</sub> may therefore have some degree of *trait* associated with it, as well as *state*.

During the one-year course of rehabilitation in *Study II*, patients' self-efficacy of knee function did increase significantly, without an intentional intervention to improve self-efficacy by the physical therapist. This is in accordance with a study of whiplash-associated disorders (WAD)<sup>28</sup> showing that a group of patients with WAD who were given supervised therapy significantly increased their self-efficacy of daily activities compared with a group of patients with WAD who were given home training.

### *Strategies to reinforce self-efficacy*

There are strategies to reinforce self-efficacy which may be used unintentionally by the physical therapist, resulting in the strengthening of the patients' self-efficacy explaining the above findings. A strategy suggested by Bandura<sup>15</sup> is *persuasion by the physical therapist*, i.e. the patients are told that they have what it takes to succeed. Another strategy suggested by Bandura<sup>15</sup> is *social modelling*, i.e. the patient sees other patients like him/herself succeed during the rehabilitation (see Introduction section, Strategies to reinforce self-efficacy, page 28).

The most effective way to strengthen a person's self-efficacy is, according to Bandura<sup>15</sup>, through *mastery experience*. A person who is successful in overcoming difficulties experiences a sense of competence, while failure undermines the sense of competence. The ability to expose the patient to difficulties or challenges that he/she can overcome successfully is a delicate matter for the physical therapist, which may require experience or a certain skill. Instruments like the K-SES could be valuable to the physical therapist in recognising the patients' degree of perceived self-efficacy of knee function. Having the patient's self-efficacy of knee function in mind may help the physical therapist to recognise the difficulties involved in mastering various functional abilities.

A factor also to consider during rehabilitation is the patients' *physical and emotional state* that may not be as easily affected. According to Bandura<sup>15</sup>, people appear to rely on their *physical and emotional state* to judge their

capabilities. Low self-efficacy for physical functioning may be interpreted as fatigue and pain when activities require strength and stamina.

In *Study IV*, the patients' perceived self-efficacy of knee function in the future became a significant predictor of outcome in terms of the degree of symptoms the patients experienced during sports and recreation, their interpretations of knee quality of life and their performance in hop for distance. This may indicate that K-SES<sub>Future</sub> determines the level of function (levels 1, 2 or 3, as described in the Introduction section, Implementation of self-efficacy, page 18), at which the patient perceives him/herself to be. Patients at level 2 or 3 of function may have doubts about their self-efficacy, as well as doubts about the benefits of their efforts, and may therefore easily give up when facing difficulties. They probably need a great deal of personal guidance to make successful rehabilitation possible. This is in agreement with Heijne<sup>49</sup>, who identified some patients that gave up because they faced more difficulties than they had expected during the rehabilitation and these patients said that more personal guidance would have helped them. A weak K-SES<sub>Future</sub> may be an indication of what is important to recognise early in the rehabilitation process in order to strengthen self-efficacy of knee function and thereby achieve an acceptable outcome of rehabilitation.

### *Self-efficacy as a predictor of rehabilitation outcome*

Some patients return relatively quickly to their previously often high physical activity level despite a seemingly severe ACL injury with associated knee injuries. Other patients have undergone seemingly successful rehabilitation following an ACL reconstruction but are still unable to return to their previous level of physical activity<sup>53,54</sup>. It would therefore be very important to be able to predict what will result in a successful rehabilitation outcome. Furthermore, it would be of value to know what actually can be done to improve the success rate.

Self-efficacy of daily living has been shown to be a significant predictor of persistent pain disability in patients with a whiplash-associated disorder<sup>29,64</sup>. A whiplash-associated disorder can be compared with an ACL injury, in terms of being sudden, unpredictable and devastating to the patient. There are, however, very few reports in the literature of predictive factors for outcome after ACL injury and rehabilitation. Heijne<sup>48</sup> was unable to find that subjective and objective measures were able to predict clinical outcome after ACL reconstruction. It was found, however, that minor pre-operative anterior knee pain or the absence of such pain was a significant predictor of a

high score on KOOS<sub>Sports/Recreation</sub> and KOOS<sub>Qol</sub> one year after surgery<sup>48</sup>. A recent study indicated that factors such as the patients' psychological profile, as well as the way patients rated their knee function capacity before surgery, could be useful in determining who will return to their pre-injury activity level after an ACL reconstruction<sup>45</sup>. The results of *Study IV* indicated that patients who pre-operatively were more certain of their knee function at present (K-SES<sub>Present</sub>) had a higher level of physical activity (Tegner<sub>Present</sub>) and a higher level of intensity/frequency of physical activity (PAS<sub>Present</sub>) one year after the ACL reconstruction. It was also seen that patients who were more certain of their future knee function (K-SES<sub>Future</sub>) perceived their symptoms one year after ACL reconstruction as being less severe and they also had better muscle function on hop for distance one year after ACL reconstruction, compared with patients who have a weak pre-operative K-SES<sub>Future</sub>. The pre-operative physical activity level, patients' psychological profile and symptoms, as well as self-efficacy of knee function, could therefore predict future physical function in patients' with an ACL injury. Taken as a whole, there appears to be greater potential for a successful outcome after surgery if the patient pre-operatively is highly physically active, has little or no anterior knee pain, has a certain personality and has a high future self-efficacy of knee function.

### *Rehabilitation, symptoms, physical function and self-efficacy*

There are a number of studies indicating the importance of well-defined, guided rehabilitation for a successful outcome<sup>10,22,63,77</sup>. A successful outcome can be defined in many ways and is a topic of discussion in the literature. An ideal treatment outcome after ACL injury is considered to be a patient with 1) full range of motion of the knee, 2) a stable knee, 3) no knee pain, 4) a good capacity for physical activity and 5) no post-traumatic knee arthritis<sup>2,44,90</sup>. Patients who have an ACL injury or have undergone an ACL reconstruction are rehabilitated towards the following five goals.

1) *A full range of motion.* An early start with range of motion exercises for the knee is now standard both after injury and after surgery. Early knee extension exercises using the quadriceps muscle have been shown not to jeopardise the stability of the knee<sup>51</sup>.

2) *A stable knee.* The ultimate goal for patients, both for those with recurrent "giving-way", who are in need of reconstructive surgery, and for those who are able to cope with the ACL injury, should be a mechanically and functionally stable knee. Training of neuromuscular control with balance and co-ordination exercises, strength exercises, as well as exercises to stimulate

## Discussion

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proprioception during the rehabilitation, may improve the functional stability. A good result for knee function was shown in a fifteen-year follow-up study of patients with an ACL-deficient knee participating in neuromuscular rehabilitation and early physical activity modification<sup>61</sup>. The question of whether the mechanical laxity after reconstruction is jeopardised by open- or closed-chain exercises is also discussed in the literature<sup>30,50,51,77</sup>.

3) *No knee pain*. Knee pain should not be a problem during the rehabilitation of patients with an ACL injury and definitely not for an acceptable rehabilitation outcome. There might be some passing pain from the donor site early in the rehabilitation and subsequently as an unpleasant feeling when kneeling on a hard surface. There is a risk with overly aggressive training during rehabilitation and overly aggressive daily activities early in the rehabilitation which could result in temporary swelling and pain. These may be temporary setbacks, but they should not be any problem when a gradual and pain/symptom monitored progress is used by the physical therapist in charge. Anterior knee pain, a common problem in the general population, may also be a problem for patients with an ACL injury, but it appears not be cured by reconstructive surgery<sup>48</sup>.

4) *A good capacity for physical activity*. ACL injuries are usually sustained during physical activity. Needless to say, the ultimate goal is to return to the same level of physical activity as before the injury. This has been shown to be more difficult than expected. It may be due to decreased muscle function<sup>81</sup> or to overly short rehabilitation periods<sup>8</sup> with insufficient information and unrealistic expectations<sup>49</sup>. Another difficulty is that, for a safe return to sports, there are no standardised and objective criteria to assess an athlete's ability to progress through the end stages of rehabilitation<sup>43,80</sup>.

5) *No post-traumatic knee arthritis*. Surgery has not been shown to inhibit post-traumatic arthritis. Who and why patients with an ACL injury acquire post-traumatic arthritis is still not clear. Symptoms of arthritis are usually detected 10-15 years after the injury, in about 40% of the patients, more commonly in women<sup>89</sup>.

In the future, it would be of interest to implement the concept and include increased knowledge of self-efficacy of knee function in the rehabilitation of patients with an ACL injury. Figure 10 illustrates a model, not evaluated in research, relating to the effects of an ACL injury, the disabilities the patients perceive and how they may affect self-efficacy of knee function. In this model, the optimal outcome of rehabilitation would be to maintain high or increase low self-efficacy of knee function for minimal perceived disability of the knee.

## Discussion

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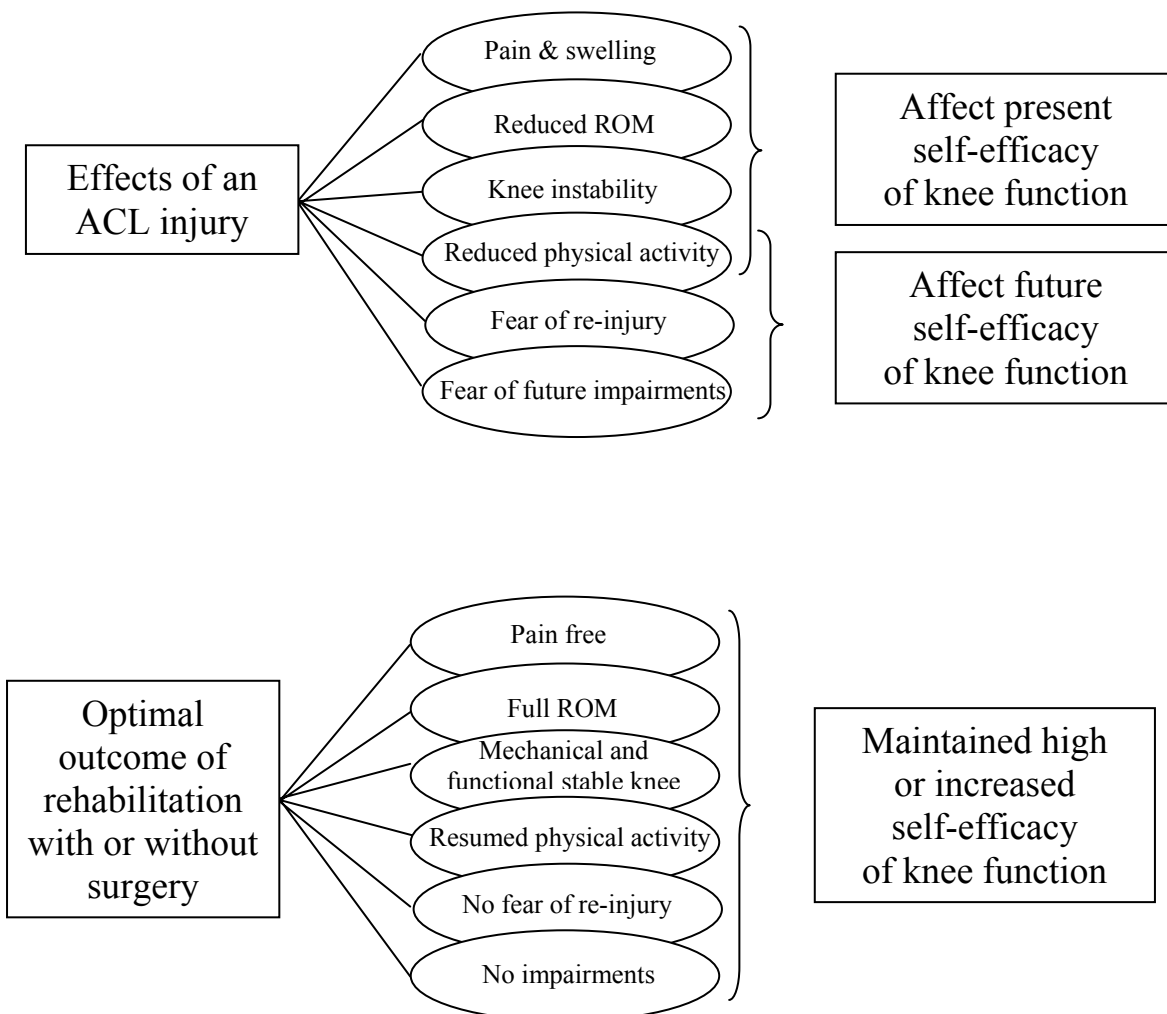


Figure 10 – A model relating to the way an ACL injury, the disabilities the patients perceive and how they may affect self-efficacy of knee function. In this model, the optimal outcome of rehabilitation would be to maintain high or increased low self-efficacy of knee function for minimal perceived disability of the knee.

It is, however, important to continue to try to understand why more patients do not achieve acceptable levels of outcome in terms of physical activity, symptoms and muscle function after ACL reconstruction.

### *Acceptable level of outcome*

Recognising the level of self-efficacy of knee function may be an important factor pre-operatively in order to ensure an acceptable outcome when it comes to the patients' function during sports/recreation and their interpretations of knee quality of life.

It is also important to recognise the different levels of function (see the Introduction section, Implementation of self-efficacy, page 27) in patients' self-efficacy of knee function to enable action to be taken during rehabilitation to bring about an acceptable outcome. Figure 11 illustrates a possible relationship between a patient with high self-efficacy of knee function and an acceptable outcome of rehabilitation after an ACL injury.

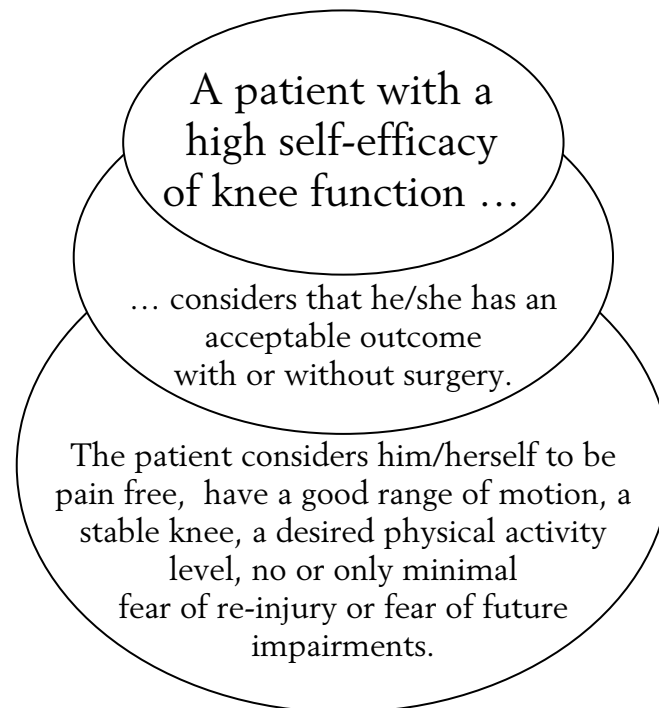


Figure 11 – Illustration of a possible relationship between a patient with high self-efficacy of knee function and an acceptable outcome of rehabilitation after an ACL injury.

It can be speculated that patients who undergo ACL reconstruction have a high sense of self-efficacy and positive outcome expectations, as they are young, active and determined early in their rehabilitation process to return to their previous level of physical activity. This is the ultimate and number one level of function according to Bandura<sup>15</sup> (see the Introduction section, Implementation of self-efficacy, page 27). Patients at this first level of function are considered to require minimal guidance to accomplish what they

## Discussion

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seek. In a qualitative study based on semi-structured interviews by Heijne<sup>49</sup> some of these patients give up easily when facing difficulties and their efforts are therefore not optimal. The rehabilitation then becomes much more demanding than they had expected. They are not well prepared for this and they end up having doubts about their self-efficacy, as well as doubts about the benefits of their efforts. There is probably a need for additional support and guidance through interactive means from doctors, physical therapists, coaches and others if they are going to have an acceptable outcome of their rehabilitation. Another important aspect may be that doctors, physical therapists, coaches and others cooperate with each other and with the patient to set a mutual and realistic goal for the rehabilitation.

The success rate for outcome in *Study IV* was defined as the percentage of patients reaching an acceptable level for *physical activity*, *symptoms* and *muscle function*. There is no gold standard for acceptable outcomes and the acceptable levels of outcome chosen in *Study IV* may appear to be high and demanding, but they are based on the literature<sup>46,47,67,81,84,105</sup>. In *Study IV*, it is noteworthy that there is a trend for almost all the pre-operative scores for *present* and *future* self-efficacy of knee function to have a higher value for those patients who reached an acceptable outcome level one year after surgery compared with those who did not. The reason for not obtaining more significant differences could be due to the small sample size.



### *The use of the K-SES*

According to the implementation model of functioning levels (see the Introduction section, Implementation of self-efficacy, page 27), patients who have low self-efficacy early in the rehabilitation process probably need a great deal of personal guidance to make successful rehabilitation possible. It appears important to recognize patients with low self-efficacy of knee function early in the rehabilitation. It also appears to be important to reinforce self-efficacy of knee function, as well as to prepare patients for surgery; otherwise, they might end up having doubts about their efficacy. Regularly evaluating perceived self-efficacy of knee function with the K-SES may help when it comes to recognising individuals that are starting to have doubts about their self-efficacy of knee function especially for those clinicians who have limited experience of patients with an ACL injury.

The K-SES may also be a valuable tool to use together with the available strategies to reinforce the patients' perceived self-efficacy of knee function during rehabilitation. Through clinical experience, a clinical goal setting model has evolved, intending to reinforce patients' self-efficacy of knee function. The clinical model is being evaluated by our research group at present, involving patients with a recently injured ACL.

### *A clinical model*

During the years in which this thesis was written, a clinical model evolved (Figure 12). There is experience from a prospective, randomised, control pilot study, but the model has to be evaluated in a larger randomised, controlled trial in the future. The model illustrates, in four phases, how the concept of self-efficacy can be implemented in rehabilitation and this can guide the physical therapist in the work of strengthening the patients' self-efficacy of knee function. The phases overlap and can start again from phase one during the rehabilitation when the patient is faced with new tasks and challenges. The goal is gradually to strengthen patients that have a low self-efficacy of knee function and maintain patients that are on a high level.

### *Phase 1 – Understanding*

The physical therapist strives to increase the patients' understanding of the ACL injury, the extent of the rehabilitation, its content and goals by giving information, demonstrating, allowing practice and some challenges.

### *Phase 2 – Maturity*

The physical therapist continues to increase the patients' understanding and to challenge and guide to increase the variety of exercises. The goal is that the patient should have several positive experiences in order for the understanding to mature.

### *Phase 3 – Stamina*

The physiotherapist continues to guide and increase the variety and complexity of the various exercises. Furthermore, tests can be included in order to evaluate how well the goals are achieved.

### *Phase 4 – Coping*

The physiotherapist continues to evaluate the rehabilitation, gives support and encouragements and tries to reinforce the patients' self-efficacy of knee function.

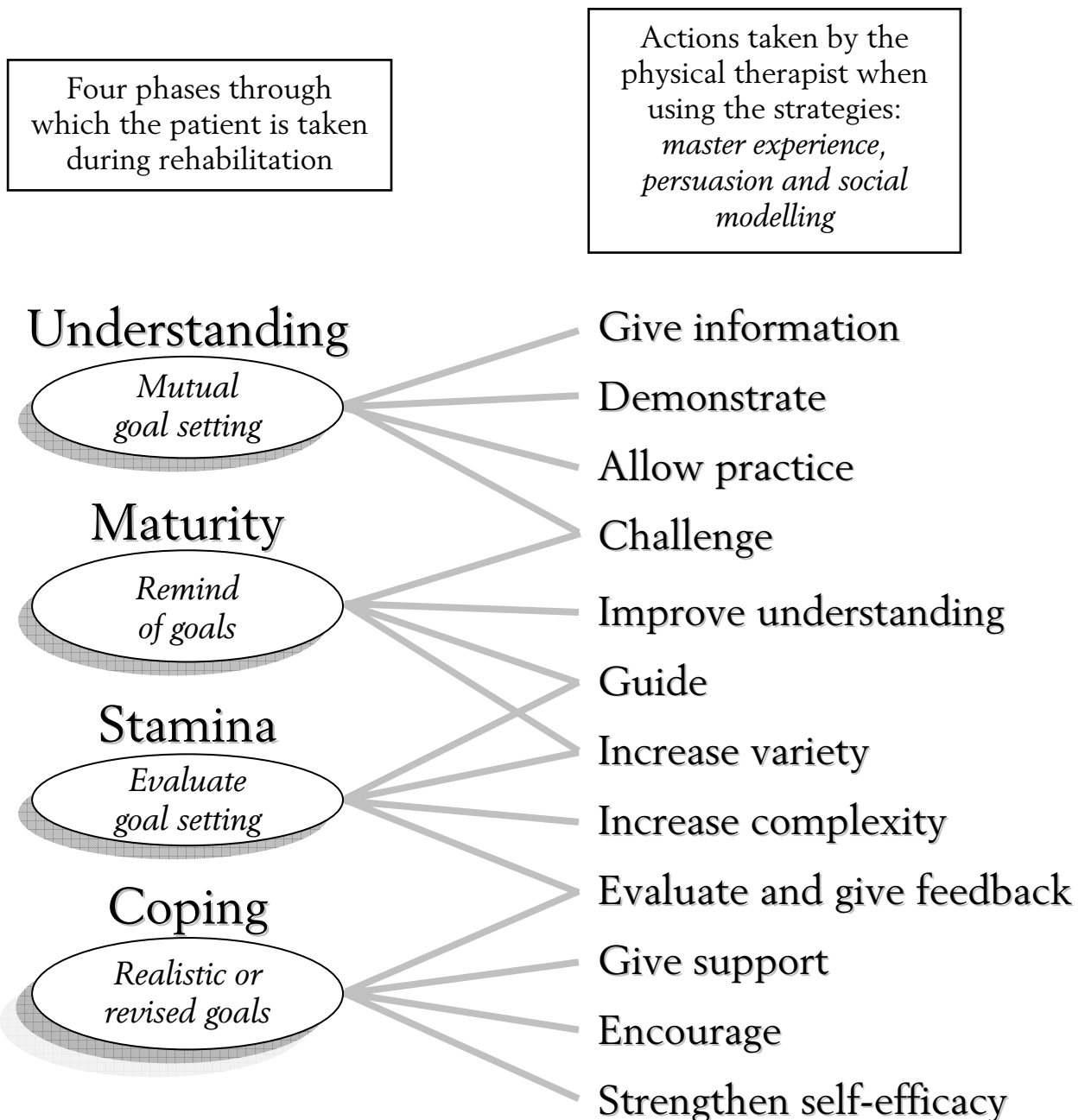


Figure 12 – A clinical model illustrating in four phases how the concept of self-efficacy can be implemented in rehabilitation to guide the physical therapist in the work of strengthening the patients' self-efficacy of knee function. The phases overlap and can start again from phase one during the rehabilitation when the patient is faced with new tasks and challenges. The goal is gradually to strengthen patients that have a low self-efficacy of knee function and maintain patients that are on a high level.

### *Suggestions for future use of the K-SES*

Measuring the patient's self-efficacy of knee function is a new approach, which might make it easier to understand and treat patients with an ACL injury. Recognition of who is in need of help with their perception of self-efficacy of knee function may be important. The K-SES is an instrument which could be useful for this purpose. It would also be of value if patients "at risk" could be identified, e.g. individuals who might not benefit from an ACL reconstruction unless satisfaction in perceived self-efficacy of knee function is accomplished.

Using their experience and skill, physical therapists should be able to reinforce self-efficacy of knee function. Strategies to reinforce self-efficacy are considered effective for other diagnoses such as heart disease, whiplash associated disorders, osteoarthritis and persistent back pain<sup>3,28,66,76</sup>. Strategies to reinforce self-efficacy of knee function have not, however, been evaluated.

Many patients with an ACL injury appear to have high self-management capabilities, i.e. level one on the implementation model (see the Introduction section, Implementation of self-efficacy, page 27), with little or no need for interactive guidance, as they appear to be determined early in the rehabilitation process to return to their previous level of physical activity. It is, however, just as important to maintain high self-efficacy of knee function for those individuals who may have no doubts as it is to strengthen those who have a low self-efficacy of knee function. Home-based rehabilitation programmes for patients with an ACL injury may work for patients at the first level one on the implementation model (see the Introduction section, Implementation of self-efficacy, page 27). However, there may be a risk in terms of the discussions of the cost benefits of the home-based programmes, which may instead cause patients to end up at level two or even three if they are not recognised in time for additional guidance and strengthening of self-efficacy. It may be important to reinforce or guide patients early in the rehabilitation process, as well as to prepare them for surgery; otherwise, they might end up having doubts about their efficacy. It also appears to be important early in the rehabilitation process to recognise those who are in need of additional guidance. Recognising low self-efficacy of daily living early in the rehabilitation process for those who are in need of additional guidance has been shown to be important for the quality of life outcome in patients with whiplash-associated disorders<sup>99</sup>. Studying whether ACL reconstruction should or should not be recommended to patients with a therapy resistant low self-efficacy of knee function, i.e. individuals who think their performance is beyond their control, may be a delicate challenge for future studies.

# Conclusions

- *The Knee Self-Efficacy Scale (K-SES)* was shown to have good face validity, as well as good content, construct and convergent validity for patients with an ACL injury.
- *The K-SES* was found to have acceptable internal consistency, as well as being reliable for test-retest
- Two factors were demonstrated for the K-SES, the sub-scale *K-SES<sub>Present</sub>* and the sub-scale *K-SES<sub>Future</sub>*. Each sub-scale should be treated separately.
- *The K-SES* was found to have the ability prospectively to detect clinically important changes (responsiveness) in patients with an ACL injury up to one year after injury/surgery.
- Significant improvement in perceived *self-efficacy* of knee function could only partly be explained by the improvement in subjective symptoms.
- A significant difference in *self-efficacy* of knee function was observed early in the rehabilitation process, between men and women, young and old, and between patients with a moderate and high pre-injury physical activity level.
- Perceived *self-efficacy* of knee function was shown to be determined by knee symptoms especially for sport and recreation, as well as for internal health locus of control, for patients with an ACL injury up to one year after injury/surgery.
- Patients' perceived *self-efficacy* of knee function pre-operatively was found to be of predictive value for their return to acceptable levels of physical activity, symptoms and muscle function one year after ACL reconstruction.

# Clinical implications and relevance

- It may be important to prepare the patient to understand the seriousness of the ACL injury before initiating any kind of treatment, especially surgery.
- Dissatisfied patients may have overly high or unrealistic expectations about the effects of surgery and they may not have been mentally prepared for the post-surgical demands of rehabilitation.
- The K-SES can be used as a clinically relevant, useful tool to recognise patients who doubt their own capacity and *self-efficacy* of knee function.
- Recognising individuals who are starting to have doubts about their *self-efficacy* of knee function may be important, especially when they are in need of additional guidance.
- The patient's perceived *self-efficacy* of knee function also appears to be an important factor in the rehabilitation of patients after an ACL reconstruction, especially in terms of the outcome associated with physical participation, subjective knee function and quality of life.
- For individuals who think that their habits are beyond their control, with a great need for structured personal guidance, ACL reconstruction is probably not recommended, unless a satisfactory perceived *self-efficacy* of knee function has been achieved.
- When negative discrepancies are experienced between aspirations and actual achievement level, performers with high *self-efficacy* will increase their level of effort and persistence, whereas low *self-efficacy* performers will give up.
- Guidance and reinforcement during rehabilitation appear to be important. Measuring the patient's *self-efficacy* of knee function is a new approach, which might make it easier to understand and treat patients with an ACL injury.

### Future research

It is suggested that future research on *the K-SES* should focus on the following issues.

- The potential for strengthening self-efficacy of knee function during rehabilitation should be studied in a prospective, randomised study using *the K-SES*.
- Evaluate whether *the K-SES* can be used as a predictor in a prospective study of a primary goal, such as return to physical activity.
- If there are different implications in using the two parts,  $K-SES_{Present}$  and  $K-SES_{Future}$ , as well as  $K-SES_{Total}$ .
- The most useful time to measure *self-efficacy* of knee function after an ACL injury.
- Study the differences between genders in terms of *self-efficacy* of knee function, as measured with *the K-SES*.
- If there are any differences in *self-efficacy* of knee function between those who undergo early or late reconstruction of the ACL, as well as those who choose no reconstruction.
- If there is a different need for rehabilitation according to level of *self-efficacy* of knee function.
- If patients “at risk”, e.g. individuals who might not benefit from an ACL reconstruction, could be identified.
- If there are ways of making the rehabilitation more economically beneficial when *self-efficacy* of knee function is taken in consideration – possibly by reducing sick leave.
- Strategies to reinforce *self-efficacy* of knee function are available, but they have not as yet been evaluated in research.
- Whether it is possible to prevent patients from “giving up” during rehabilitation.
- The use of *the K-SES* for other diagnoses?

### *En klinisk modell*

Under åren som detta avhandlingsarbete genomförts har en klinisk modell vuxit fram (Figur 12). Erfarenheter finns från en genomförd pilotstudie, men framtida studier får utvisa effekten av behandlingsmodellen. Modellen illustrerar hur konceptet tilltro till sin förmåga för knäfunktion kan implementeras under rehabiliteringen i fyra faser. Faserna flyter in i varandra och kan börja om från fas 1, när patienten under rehabiliteringen ställs inför nya uppgifter. Målsättningen är att successivt stärka en låg tilltro eller bibehålla en hög tilltro.

### *Fas 1 – Förståelse*

Sjukgymnasten strävar efter att öka patientens förståelse för korsbandsskadan, rehabiliteringens omfattning, innehåll och olika delmål genom att informera, demonstrera, låta patienten prova på och ställas inför "lagom" utmaningar.

### *Fas 2 – Mognad*

Sjukgymnasten fortsätter att öka förståelsen, utmana, styra och öka mångfalden. Målsättningen är att patienten skall få flera positiva upplevelser så att förståelsen mognar.

### *Fas 3 – Kämpande*

Sjukgymnasten fortsätter styra och öka mångfalden och komplexiteten i träningsövningarna. Dessutom kan tester börja införas för att utvärdera hur de olika delmålen uppfylls.

### *Fas 4 – Hantering*

Sjukgymnasten fortsätter utvärdera rehabiliteringen, stödjer, uppmuntrar och försöker stärka patientens tilltro till sin förmåga för knäfunktion så att patienten kan återgå till ett normalt liv samt sitt motions- och idrottsutövande.



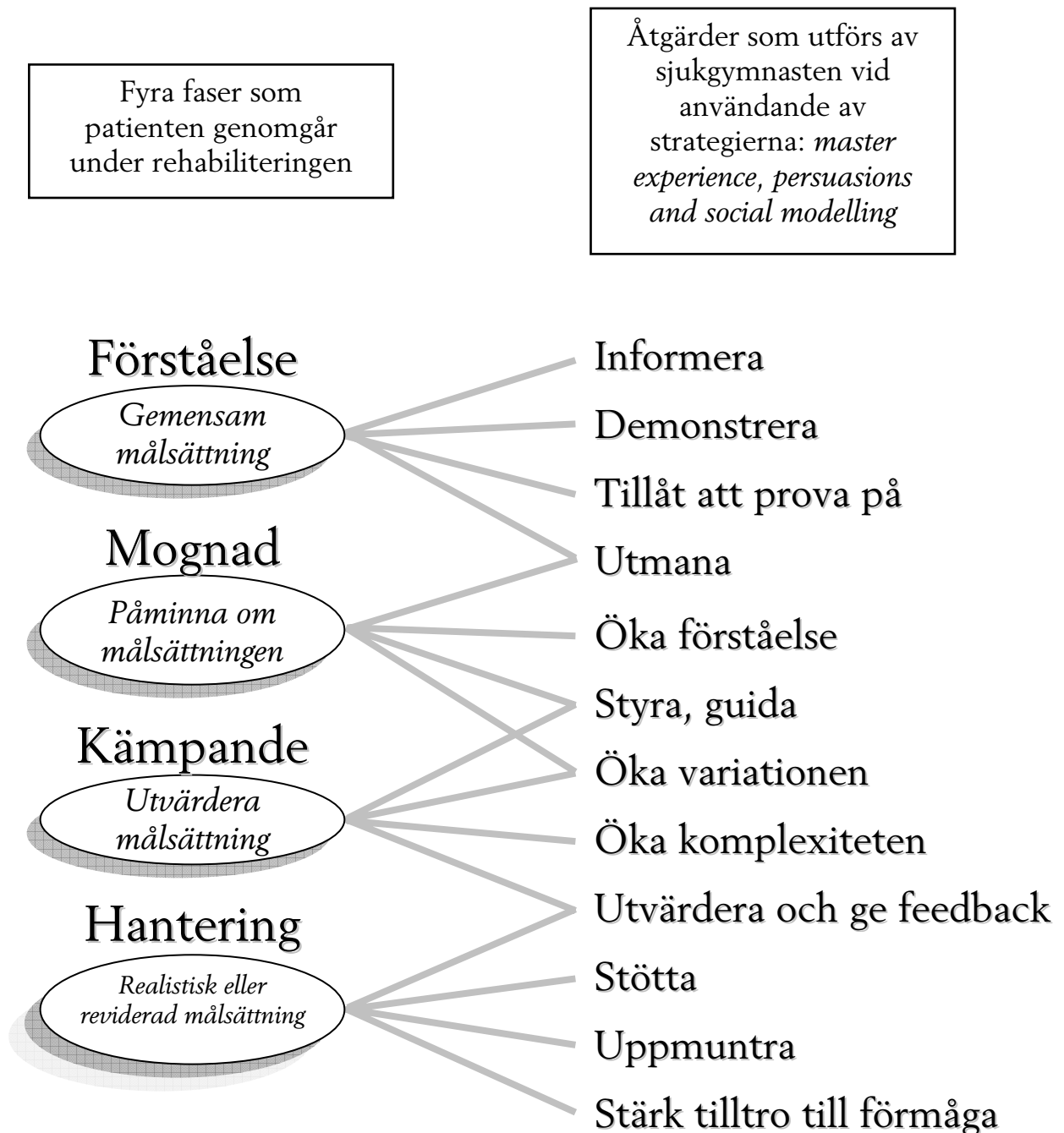


Figure 13 – En klinisk modell som illustrerar hur konceptet tilltro till sin förmåga för knäfunktion kan implementeras under rehabiliteringen i fyra faser. Faserna flyter in i varandra och kan börja om från fas ett, när patienten under rehabiliteringen ställs inför nya uppgifter. Målsättningen är att successivt stärka en låg tilltro eller bibehålla en hög tilltro.

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## To people with an Anterior Cruciate Ligament injury

A questionnaire on:

How certain you are about your ability  
to manage different activities **right now**

and

How certain you are about your  
knee function in **the future**

You should only give **your perception of** how certain  
**you are about your ability** to manage the activities  
and not how well you actually can perform the activities.

If you never have tried the activity, you should say  
what you believe your ability is.

## Appendix 2 – The K-SES instrument

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### A. Daily activities

Mark the box with the number that best represents how certain you are about the activity right now despite pain/discomfort.

	0 = not at all certain					10 = very certain					
How certain are you about:	0	1	2	3	4	5	6	7	8	9	10
1) taking a walk in the forest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) climbing up and down stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) going out dancing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) jumping ashore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5) running after small children	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6) running for the tram/bus	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7) working in the garden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

---

### B. Sports and leisure activities

Mark the box with the number that best represents how certain you are about the activity right now despite pain/discomfort.

	0 = not at all certain					10 = very certain					
How certain are you about:	0	1	2	3	4	5	6	7	8	9	10
1) bicycling long distances	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) cross-country skiing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) horseback riding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) swimming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5) hiking in the mountains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Appendix 2 – The K-SES instrument

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### C. Physical activities

Mark the box with the number that best represents how certain you are about the activity right now despite pain/discomfort.

	0 = not at all certain					10 = very certain					
How certain are you about:	0	1	2	3	4	5	6	7	8	9	10
1) squatting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) jumping sideways from one leg to the other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) working out hard a short time after an injury	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) performing a one-leg hop on the injured leg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5) moving around in a small boat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6) doing fast twisting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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### D. Your knee function in the future

Mark the box with the number that best represents how certain you are about the activity in the future.

	0 = not at all certain					10 = very certain					
	0	1	2	3	4	5	6	7	8	9	10
1) How certain are you that you can participate on the same activity level as before the injury?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) How certain are you that you will not have new knee injuries?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) How certain are you that your knee will not “break down”?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) How certain are you that your knee will not get worse than before surgery (only for people who have had surgery)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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*Göteborgs Universitet*

## Till dig som är korsbandsskadad

Frågeformulär om:

hur säker du är på din förmåga  
att klara av olika aktiviteter **just nu**

och

hur säker du känner dig på  
hur ditt knä skall fungera **i framtiden**

Du skall endast svara på *din upplevelse* av  
**hur säker du är på din förmåga**  
att klara av de olika aktiviteterna  
och inte på hur bra du faktiskt klarar av det.

Har du aldrig provat på aktiviteten tidigare,  
så kryssa i hur säker du **tror dig vara**.

Den svenska versionen av K-SES kan laddas ner som pdf  
från: [www.orthopaedics.gu.se/forskning/avhandlingar](http://www.orthopaedics.gu.se/forskning/avhandlingar)

### A. Dagliga aktiviteter

*Kryssa i rutan för* den siffra som bäst beskriver *hur säker du är på din förmåga* att kunna utföra aktiviteten *just nu* oavsett smärta/besvär.

	0 = inte alls säker					10 = mycket säker					
Hur säker är du på att:	0	1	2	3	4	5	6	7	8	9	10
1) gå i skogen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) gå nedför backar/trappor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) gå ut och dansa	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) hoppa iland från en båt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5) springa efter små barn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6) springa till spårvagn/buss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7) arbeta i trädgården	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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### B. Fritids-, motions- och idrottsaktiviteter

*Kryssa i rutan för* den siffra som bäst beskriver *hur säker du är på din förmåga* att kunna utföra aktiviteten *just nu* oavsett smärta/besvär.

	0 = inte alls säker					10 = mycket säker					
Hur säker är du på att:	0	1	2	3	4	5	6	7	8	9	10
1) cykla längre sträckor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) åka längdskidor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) rida	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) simma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5) fjällvandring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### C. Fysiska aktiviteter

*Kryssa i rutan för* den siffra som bäst beskriver *hur säker du är på din förmåga* att kunna utföra aktiviteten *just nu* oavsett smärta/besvär.

	0 = inte alls säker					10 = mycket säker					
Hur säker är du på att:	0	1	2	3	4	5	6	7	8	9	10
1) att sitta på huk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) att hoppa i sidled från ett ben till det andra	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) att träna hårt en kort tid efter skada el. oper.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) att göra enbenshopp på det skadade benet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5) att kliva omkring i en gungande mindre båt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6) att göra snabba vändningar	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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### D. Din knäfunktion i framtiden

*Kryssa i rutan för* den siffra som bäst beskriver just nu *hur säker du är på din förmåga* i framtiden.

	0 = inte alls säker					10 = mycket säker					
	0	1	2	3	4	5	6	7	8	9	10
1) Hur säker är du på att du skall kunna återgå till din idrott på samma nivå som före skadan?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2) Hur säker är du på att du inte får nya skador i ditt knä?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3) Hur säker är du på att ditt knä inte skall "gå sönder"?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4) Hur säker är du på att ditt knä inte blir sämre än före operation (för dig som är opererad)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

# Acknowledgements

This book would not exist without the persuasion that I could do it, the encouragement to master it and the opportunity given to me by all of you. I would therefore like to express my sincere gratitude to everyone who has made this thesis possible. There are, however, some people that I would like to give a special acknowledge in particular.

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