Return to Sport after Hip Arthroscopy. Perspectives on a journey with many destinations.

Wörner, Tobias

2021

Document Version:
Publisher's PDF, also known as Version of record

Return to Sport after Hip Arthroscopy

Perspectives on a journey with many destinations

TOBIAS WÖRNER
DEPARTMENT OF HEALTH SCIENCES | LUND UNIVERSITY

Return to Sport after Hip Arthroscopy

Perspectives on a journey with many destinations

Tobias Wörner

LUND
UNIVERSITY

DOCTORAL DISSERTATION

by due permission of the Faculty of Medicine, Lund University, Sweden.
To be defended at H02, HSC, Baravägen 3, Lund on 23 September 2021 at 1 pm.

Faculty opponent
Professor Jón Karlsson
Department of Orthopaedics, Institute of Clinical Sciences, Sahlgrenska Academy,
University of Gothenburg, Gothenburg, Sweden.

Organization	Document name
LUND UNIVERSITY	DOCTORAL DISSERTATION
Department of Health Sciences Physiotherapy	**Date of issue** September 23
Author(s): Tobias Wörner	Sponsoring organization

Title and subtitle: Return to sport after hip arthroscopy: Perspectives on a journey with many destinations

Abstract

Femoroacetabular impingement (FAI) syndrome is often treated with hip arthroscopy (HA) with the goal of enabling return to sport. While the number of HAs has been rising, little is known about the rehabilitation process or about outcomes related to return to sport (RTS) following the procedure. The overarching aim of this thesis was to describe the rehabilitation process following HA in Scandinavia and to investigate RTS and factors potentially associated with it.

We described current rehabilitation strategies following HA in Scandinavia by surveying specialized clinicians (62 physiotherapists and 28 surgeons) in Denmark, Norway, and Sweden. We then cross-sectionally described RTS rates in 127 patients 3–39 months following HA for FAI syndrome, defining RTS on a continuum according to consensus terminology. Subsequently, we measured patient-reported and clinically measured hip function in 33 patients 6–10 months following HA, comparing these patients with a healthy control group in a cross-sectional study. Finally, we modified and validated a patient-reported outcome measure, i.e., Hip—Return to Sport after Injury (Hip-RSI) scale, to assess psychological readiness to RTS in HA patients.

Clinicians rated structured rehabilitation as very important and reported similar expectations regarding the rehabilitation timeline during the first three months following HA for FAI syndrome. Approaching RTS, clinicians' expectations increasingly varied, with surgeons being more optimistic than physiotherapists. Nine out of ten patients returned to some sort of sport or physical activity, while half returned to their previous sport and only one out of five returned to their previous performance level. During the time when patients could be expected to RTS, they displayed impairments in self-reported hip function and in measures related to hip mobility. The Hip-RSI displayed adequate psychometric properties to be recommended as a valid tool in the assessment of psychological readiness in HA patients.

In the absence of evidence-based rehabilitation protocols following HA, a description of current clinical practice may serve as a first step toward establishing clinical consensus, also highlighting areas for future research. Our description of RTS rates may be used to create realistic patient expectations regarding RTS. Impairments in hip mobility and mobility-related performance may influence but cannot fully explain observed RTS rates and impairments in self-reported function. Psychological readiness to RTS may play an important role in the RTS process following HA and can now be assessed and investigated further with the help of the Hip-RSI.

Key words: Hip arthroscopy; Femoroacetabular impingement; Return to sport; Rehabilitation; Physiotherapy; Performance; Muscle strength; Range of motion; Psychological readiness

Classification system and/or index terms (if any)

Supplementary bibliographical information		**Language** English
ISSN 1652-8220 and key title		**ISBN** 978-91-8021-095-9
Recipient's notes	**Number of pages** 65	Price
	Security classification	

Signature  Date 2021-08-18

Return to Sport after Hip Arthroscopy

Perspectives on a journey with many destinations

Tobias Wörner

LUND
UNIVERSITY

Cover art by Nilo Wörner

Faculty of Medicine
Department of Health Sciences

ISBN 978-91-8021-095-99
ISSN 1652-8220
Lund University, Faculty of Medicine Doctoral Dissertation Series 2021:88

Printed in Sweden by Media-Tryck, Lund University
Lund 2021

The greatest deception men suffer is from their own opinions.

(Leonardo da Vinci)

Table of contents

Abstract

Femoroacetabular impingement (FAI) syndrome is often treated with hip arthroscopy (HA) with the goal of enabling return to sport (RTS). While the number of HAs has been rising, little is known about the rehabilitation process or about outcomes related to RTS following the procedure. The overarching aim of this thesis was to describe the rehabilitation process following HA in Scandinavia and to investigate RTS and factors potentially associated with it.

We described current rehabilitation strategies following HA in Scandinavia by surveying specialized clinicians (62 physiotherapists and 28 surgeons) in Denmark, Norway, and Sweden. We then cross-sectionally described RTS rates in 127 patients 3–39 months following HA for FAI syndrome, defining RTS on a continuum according to consensus terminology. Subsequently, we measured patient-reported and clinically measured hip function in 33 patients 6–10 months following HA, comparing these patients with a healthy control group in a cross-sectional study. Finally, we modified and validated a patient-reported outcome measure, i.e., Hip—Return to Sport after Injury (Hip-RSI) scale, to assess psychological readiness to RTS in HA patients.

Clinicians rated structured rehabilitation as very important and reported similar expectations regarding the rehabilitation timeline during the first three months following HA for FAI syndrome. Approaching RTS, clinicians' expectations increasingly varied, with surgeons being more optimistic than physiotherapists. Nine out of ten patients returned to some sort of sport or physical activity, while half returned to their previous sport and only one out of five returned to their previous performance level. During the time when patients could be expected to RTS, they displayed impairments in self-reported hip function and in measures related to hip mobility. The Hip-RSI displayed adequate psychometric properties to be recommended as a valid tool in the assessment of psychological readiness in HA patients.

In the absence of evidence-based rehabilitation protocols following HA, a description of current clinical practice may serve as a first step toward establishing clinical consensus, also highlighting areas for future research. Our description of RTS rates may be used to create realistic patient expectations regarding RTS. Impairments in hip mobility and mobility-related performance may influence but cannot fully explain observed RTS rates and impairments in self-reported function. Psychological readiness to RTS may play an important role in the RTS process following HA and can now be assessed and investigated further with the help of the Hip-RSI.

Popular science summary

In response to high-impact physical activity, the hip joint may adapt its shape during skeletal growth in adolescence. While this change in joint shape can be a normal adaptation in many individuals, others will develop groin pain and other symptoms that affect activities of daily living and the ability to participate in sport. The combination of altered hip shape, symptoms, and clinical signs is called femoroacetabular impingement syndrome, referring to the two bony parts of the hip joint, the femur (ball of the joint) and acetabulum (socket of the joint). Femoroacetabular impingement syndrome can be treated with keyhole surgery, a procedure during which a small camera and surgical instruments are inserted into the joint without opening it. During the procedure, which increased greatly in popularity during the first 15 years of the new millennium, surgeons reshape the hip joint to improve congruency. Many patients decide to undergo this surgery (henceforth, "hip arthroscopy") to reduce pain, improve daily functioning, and RTS. However, while more and more patients are receiving this treatment, we know very little about their journey towards RTS. As healthcare professionals treating these patients, we want to inform patients about their prognosis. To do this, we need information about the expected rehabilitation timeline and the end result. In this PhD project, we describe the rehabilitation and RTS process in hip arthroscopy patients by surveying clinicians and patients and by investigating clinical outcomes.

In the first study, we surveyed experienced clinicians (physiotherapists and orthopedic surgeons) about their perspectives on and experiences of the rehabilitation process. These clinicians had similar expectations regarding the rehabilitation timeline during the first three months of rehabilitation, when biological healing times determine the pace of progress. Expectations increasingly varied as the potential RTS approached. Surgeons were also more optimistic than physiotherapists when estimating the time needed to RTS. We went on and asked a large group of patients whether they returned to sport following their arthroscopy. Instead of treating RTS as black or white by asking a yes/no question, we treated it as a continuum and asked whether patients did not RTS or whether they returned to any sport, their previous sport, or previous performance level. Ninety percent of patients returned to some kind of sport, half of them returned to their previous sport, but only one out of five returned to their previous performance level. To explore potential reasons for these relatively low return rates, we looked more closely at the hip function of patients 6–10 months following surgery, when they were expected to RTS. We collected patient-reported hip function and clinically measured different aspects of hip function in a group of patients, comparing the results with those for a control group without hip complaints. While patients reported significant impairments in self-reported hip function (especially related to sport participation and physical activity) compared with the control group, we found only small impairments related to hip mobility in patients versus controls. Hence, physical hip

function alone does not appear to explain the reasons for our observed RTS rates. We therefore modified an existing questionnaire for knee patients—the Psychological Readiness to Return to Sport Scale—to assess another dimension of the RTS puzzle following hip arthroscopy; the modified instrument is called Hip-RSI. We found the questionnaire to be appropriate for surveying hip arthroscopy patients, and that patients who had returned to higher levels of sport also had higher psychological readiness.

This thesis provides important information about the rehabilitation process to clinicians treating patients after hip arthroscopy. Patients can now be given a nuanced prognosis regarding their RTS and the research community can use the Hip-RSI to further investigate the role of psychological readiness in the RTS process after hip arthroscopy.

List of papers

I. Wörner T, Thorborg K, Moksnes H, Eek F. Similar views on rehabilitation following hip arthroscopy among physiotherapists and surgeons in Scandinavia: A specialized care survey. Knee Surg Sports Traumatol Arthrosc. 2018;26(8):2519–26.

II. Wörner T, Thorborg K, Stalman A, Webster KE, Momatz Olsson H, Eek F. High or low return to sport rates following hip arthroscopy is a matter of definition? Br J Sports Med. 2018;52(22):1475–6.

III. Wörner T, Nilsson J, Thorborg K, Granlund V, Stalman A, Eek F. Hip function 6 to 10 months after arthroscopic surgery: A cross-sectional comparison of subjective and objective hip function, including performance-based measures, in patients versus controls. Orthop J Sports Med. 2019;7(6):2325967119844821.

IV. Wörner T, Thorborg K, Webster KE, Stalman A, Eek F. Psychological readiness is related to return to sport following hip arthroscopy and can be assessed by the Hip—Return to Sport after Injury scale (Hip-RSI). Knee Surg Sports Traumatol Arthrosc. 2020;29(5):1353–61.

Abbreviations

ADL: Activities of daily living

ACL-RSI: Anterior Cruciate Ligament–Return to Sport after Injury Scale

ANOVA: Analysis of variance

CI: Confidence interval

FADIR test: Flexion-Adduction-Internal Rotation test

FAI syndrome: Femoroacetabular impingement syndrome

HA: Hip arthroscopy

HAGOS: Copenhagen Hip and Groin Outcome Score

HOS: Hip Outcome Score

HSAS: Hip Sports Activity Scale

IAT: Illinois Agility Test

ICF: International Classification of Functioning, Disability, and Health

iHOT: International Hip Outcome Tool

IQR: Interquartile range

LCEA: Lateral center-edge angle

NRS: Numeric Rating Scale

PBM: Performance-based measure

PROM: Patient-reported outcome measure

ROM: Range of motion

RTS: Return to sport

SD: Standard deviation

THT: Medial/Lateral Triple Hop Test

VAS: Visual analog scale

YBT: Y-Balance Test

Prelude

In November 2014, a small group of surgeons and physiotherapists from Capio Artro Clinic attended the 6th International Hip Arthroscopy Meeting in Munich, Germany. The program promised two full days of live surgeries and scientific presentations from the world's best hip surgeons. And the program delivered—multiple live surgeries and a plethora of interesting "how to" talks about hip arthroscopy. Two physiotherapist colleagues and I, knowing that we would never hold an arthroscope in our hands, were looking forward to one of the last sessions, called "Miscellaneous," a short presentation on postoperative rehabilitation. When it was time for this session, a surgeon stepped on stage, took the microphone, and said: "Unfortunately the presentation about the rehab problem has to be cancelled." Yes, he said "rehab problem," but I believe he meant rehab program. Nevertheless, my colleagues and I looked at each other, aware that we did have a rehab problem.

In the clinic, we faced, and to a certain extent still face, this rehab problem on a daily basis. There and then, the first thoughts about the project I will describe in this thesis went through my head. Sitting in the conference audience, as a physiotherapist among surgeons, I started to think about how I could help solve this problem, elegantly described by the surgeon's Freudian slip. At that time, hip arthroscopies were being performed left and right, so I had plenty of opportunities to reflect on and become more aware of the problem. I started an email conversation with Frida Eek about possible ways to answer my questions. In these emails, clinical questions became research questions, possible methods to answer these research questions were proposed, and a potential PhD project was born. I became a PhD student, Frida, on the other side of the e-mail conversation, became my main supervisor, and, in this book, you are about to read about the journey and what we have found.

Introduction

In this thesis I describe aspects of the rehabilitation process and the return to sportRTS journey following hip arthroscopy for femoroacetabular impingement syndrome from different perspectives. Throughout the thesis, I present the perspective of the patient as well as the clinician (orthopedic surgeon and physiotherapist), but I will also take a closer look at the outcomes of treatment (surgery and rehabilitation) with respect to and physical activity. Let me first describe the context of the project and introduce the patient population studied.

Femoroacetabular impingement (FAI) syndrome

In 2016, a multidisciplinary group of experts, with research interest and clinical expertise in treating patients with hip complaints, reached consensus on the definition of FAI syndrome (1). In this consensus paper, called the Warwick Agreement, the experts defined FAI syndrome as "a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs, and imaging findings." In other words, a clinical diagnosis of FAI syndrome must be based on what the patient tells us (history), what we find when we examine the patient (physical assessment), and the given anatomy (hip morphology seen on radiographs) (Figure 1).

The morphological variations underlying FAI syndrome were described throughout the 20th century (2, 3), but the term "femoroacetabular impingement" was coined by a Swiss group of surgeons in the early 2000s (4). These surgeons proposed two morphological variations that result in mechanical impingement of the hip joint (ball and socket joint). Impingement occurs during early abutment of the femoral head (ball) and acetabulum (socket) during hip flexion and internal rotation (4) (Figure 2). The first variation is characterized by overcoverage of the acetabulum in relation to the femoral head and was initially called pincer impingement, though it is now referred to as pincer morphology. The second variation is characterized by a prominent femoral head neck junction resulting in an aspherical femoral head and was initially called cam-impingement, though it is now referred to as cam morphology.

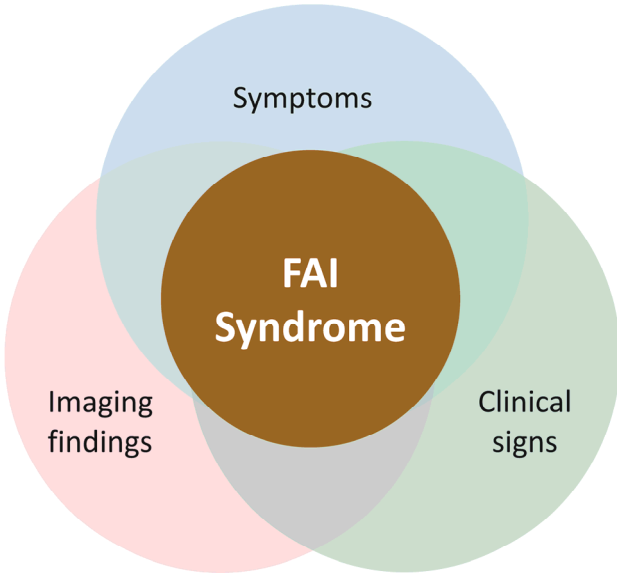


Figure 1: Femoroacetabular (FAI) syndrome. Adapted from Griffin et al. BJSM (2016).

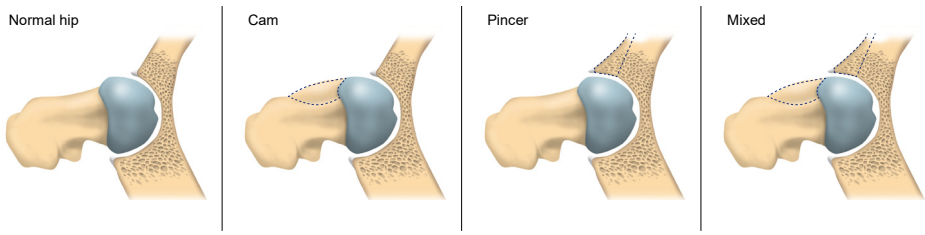


Figure 2: Hip morphology. Anatomical variations are marked with a dashed line.

These morphological variations, however, are also very common in people without symptoms. In the general population without any hip and groin pain or symptoms, cam morphologies are prevalent in 23% and pincer morphology in 67% (5). Cam morphology is more than twice as common (55%) among athletes as among non-athletes (5). The development of cam morphology, which is much better understood than pincer morphology, is associated with high-impact sporting activities during skeletal growth (6-8) and appears to be completed at the end of skeletal growth (9, 10). Considering the link between hip morphology and sporting activity during skeletal growth as well as the high proportion of athletes with morphological variations and no symptoms, it is not unreasonable to argue that radiographic findings may be a sign of normal adaptation rather than pathology. Parallels can be drawn from an evolutionary perspective when looking at mammals other than humans. Mammals that spend most of their time running and jumping usually have

aspheric femoral heads (cam morphology), while animals climbing trees or swimming in water usually have more spherical femoral heads (11). Evidence of morphological variation should therefore not be mistaken for evidence of pathology. The Warwick Agreement reinforces this sentiment by advocating against treating the scan but for treating the patient with radiological findings, symptoms, and clinical signs—i.e., the patient with FAI syndrome (1).

The patient with FAI syndrome

Since the etiology of cam morphology is associated with athletic activity during skeletal growth, it is unsurprising that the typical patients with FAI syndrome presenting to our clinics are young and physically active (12, 13). They typically are participating in high-impact sports such as soccer and ice hockey that involve quick changes in direction and repetitive frontal- and coronal-plane motion in hip flexion (14). In accordance with the Warwick Agreement (1), clinical diagnosis of FAI syndrome is based on the triad of symptoms, clinical findings, and radiological findings.

Symptoms

Most patients with FAI syndrome will say that they are experiencing pain in the groin region (13, 15, 16). Although FAI syndrome pain may be experienced in various areas around the pelvis, groin pain is the most common, and the pain normally does not radiate below the knee (13). Symptoms are usually related to activity (13), but patients can often still participate in their sports, despite worsening symptoms afterwards. Certain activities such as sudden changes in direction, hip flexion (e.g., from playing defense in basketball), or hip rotation (e.g., in ice hockey goaltending) often provoke symptoms. Besides these activity-related symptoms, patients often also experience position-related pain during activities of daily living, such as sitting, driving a car, or putting on shoes and socks (13, 15). Patients often experience these activity- and position-related impairments to be related to reduced range of motion (ROM) of the hip joint (1).

Clinical signs

Impaired ROM is often reported by patients and considered part of the physical manifestation of FAI syndrome (1). While impaired and painful hip flexion and internal rotation are reportedly an assessment finding to look for in suspected FAI syndrome, the literature is conflicting regarding whether hip ROM is impaired in FAI syndrome patients in comparison with people with healthy hips (17). In general,

one cannot “rule in” FAI syndrome as a diagnosis based on a physical exam, but must “rule out” other sources of pain until the hip joint is the last, and most likely, diagnosis left (18). The clinical uncertainty of this assessment is due to the low specificity of the available tests (19). The specificity of a diagnostic test refers to the proportion of patients without the disease being tested for who have a negative test result (i.e., true negatives). The most used test for FAI syndrome, the Flexion Adduction Internal Rotation (FADIR) test, has a specificity of 0.05, meaning that 95 of 100 times one tests a patient without FAI syndrome, this patient still has a positive test result (i.e., false positive) (19). Luckily, the FADIR test and other tests we can use to rule out other sources of pain, such as lower back pain, are very sensitive. The sensitivity of a diagnostic test refers to the proportion of patients with the disease being tested for who have a positive test result (i.e., true positives). The FADIR test has a sensitivity of 0.99 (19), meaning that just one out of 100 patients with FAI syndrome will have a negative test (i.e., false negative). Hence, if the FADIR is negative, one can be quite certain that the patient does not have FAI syndrome. When the FADIR is positive and the preceding tests for other sources of pain are negative, there is a case for looking at hip morphology to see whether, taken together, anamnesis, examination results, and morphology can explain the patient’s problems.

Radiological findings

Hip morphology is assessed using different radiographic methods, but a plane anteroposterior radiograph (x-ray) is the recommended method for the quantification of cam and pincer morphology (1). The flattening or convexity of the femoral head neck junction that characterizes cam morphology (4) is quantified in terms of the alpha angle (20). The alpha angle is defined as the angle between a) a line from the center of the femoral head through the center of the femoral neck and b) a line from the center of the femoral head to the point at which the contour of the femoral head–neck junction first leaves a circle of best fit placed around the femoral head (Figure 3). Different cutoff magnitudes of the alpha angle have been proposed to determine the presence of cam morphology (20-22), but >60° appears to clearly distinguish normal from abnormal alpha angles (21). Morphological variations of the acetabulum can range from overcoverage of the superolateral acetabulum in relation to the femoral head (pincer morphology) to undercoverage of the femoral head by the acetabulum (acetabular dysplasia). Acetabular morphology is often quantified by the lateral center edge angle (LCEA) (23). The LCEA lies between a vertical line through the center of the femoral head and a second line from the center of the femoral head to the most lateral part of the weight-bearing acetabular sulcus (23). As in the case of the alpha angle, there are discussions of LCEA cutoffs for defining the presence of pincer morphology and acetabular dysplasia, but angles of <40° and >20°, respectively, are commonly used (24).

FAI syndrome and osteoarthritis of the hip

Development of the morphological variation itself does not cause symptoms. The symptoms usually appear in the early twenties and mid-thirties (25). The mechanical reasoning behind the patient's symptoms is the impingement during hip motion damaging the articular cartilage of the acetabulum (4, 26). Patients with cam or pincer morphology have distinct patterns of cartilage damage (27) associated with severity of symptoms and poor treatment outcomes (28, 29). These cartilage changes may represent early signs of hip osteoarthritis, a condition associated with cam morphology. Size seems to matter regarding the link between the magnitude of cam morphology and the development of hip osteoarthritis, since larger alpha angles are associated with higher risk of osteoarthritis (30). Nevertheless, it is important to acknowledge that the link between magnitude of cam morphology and hip osteoarthritis has been established in patients over 44 years of age (21). The link between the presence and magnitude of cam morphology in younger populations and the development of hip osteoarthritis has not been investigated prospectively to date. Pincer morphology does not appear to play a role in this process (30) and may in some cases even have a protective effect (23).

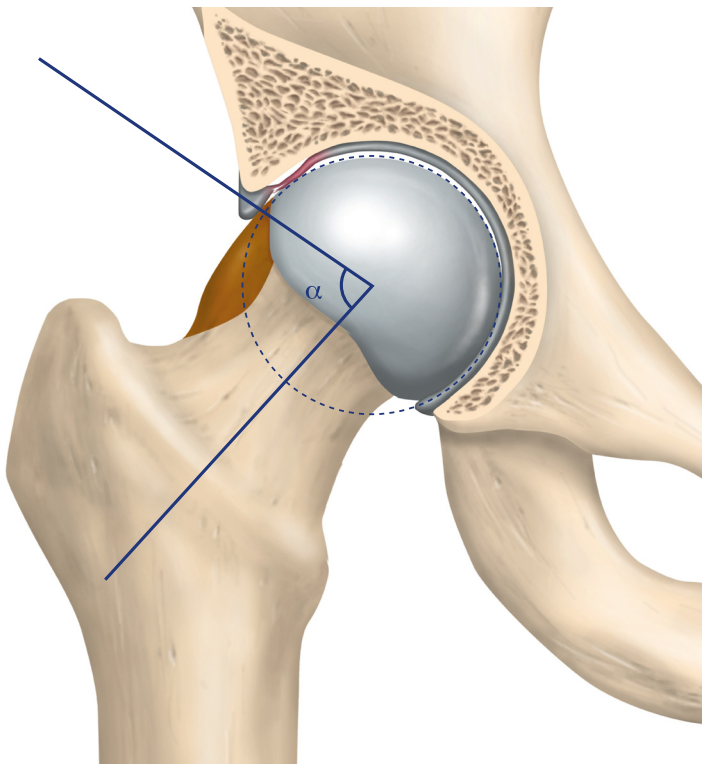


Figure 3: The alpha angle.

Treating the patient with FAI syndrome

In 1936 a surgeon from the United States published an article describing the surgical treatment of patients who today would be classified as having cam and pincer morphology (3). His colorful description of the first patient and the reasoning concerning the patient's symptoms still resonate in the current literature and the underlying rationale for performing surgery on FAI syndrome patients:

> The question to be answered was this: 'What is the source of this patient's pain?' The answer was: 'The impingement of the femoral neck on the anterior acetabular margin.' Such impingement would result in 'traumatic arthritis' with characteristic changes of the joint surfaces as well as the synovium. (3)

With these statements, Smith-Petersen set the stage for his paper describing the surgical removal of cam and pincer morphology, but he also described the mechanical reasoning regarding hip arthroscopy for FAI syndrome and suggests that surgery may play a role in preventing future hip osteoarthritis. Almost a century later, hip arthroscopy is called hip preservation surgery and the mechanical reasoning regarding surgery for FAI syndrome remains. Cam and pincer morphology are related to secondary cartilage injuries in the acetabulum and the femoral head (27, 28, 31, 32). However, despite a convincing argument for the prevention of hip osteoarthritis by removing cam and pincer morphology (31), this preventive effect has not been investigated prospectively. In recent years, hip arthroscopy has been shown to be effective in reducing pain and improving function in patients with FAI syndrome (33-35), but considerable levels of symptoms and disability remain after treatment (36, 37). These remaining disabilities may indicate that removing cam and pincer morphology treats the cause of the damage but not the damage itself: the cartilage injuries that may present in early hip osteoarthritis (38).

Since arthroscopic treatment of FAI syndrome was popularized in the early 2000s, the number of hip arthroscopies performed has been rising exponentially worldwide (39-43). Here in Sweden, we can also observe this development, with exponential increases in yearly hip arthroscopies until 2014, when the rates started to decline steadily (44). During that time, questions were raised in the orthopedic community as to whether increasing arthroscopy rates might have gone beyond the existing evidence (45). The results of the first randomized controlled trials comparing hip arthroscopy with non-surgical treatment have been published in recent years (34, 35, 46), and more such research is expected (47). Two published trials show that patients improve following both non-surgical and arthroscopic treatment (with following rehabilitation), but that arthroscopy yields larger improvements in direct comparison (34, 35). The effect sizes of treatment differences are relatively small but statistically significant and are deemed clinically relevant. Clinical relevance was, in both trials, considered if treatment effects were larger than the minimal

clinically important differences in the primary outcomes. The primary outcomes in the two trials were two patient-reported outcomes, the International Hip Outcome Tool (iHOT33) in the first and the Hip Outcome Score, Activity of Daily Living subscale (HOS-ADL) in the second. In both trials, arthroscopic treatment beat non-surgical treatment by just over the minimal clinically important difference, with absolute treatment differences of 6.8 (34) and 10 points (35) on 100-point scales. The end result of arthroscopic treatment corresponded to an improvement in hip-related quality of life (iHOT33) of 39.2/100 points to 58.8/100 points in the first trial and an improvement in hip-related function in activity of daily living (HOS-ADL) of 66.1/100 points to 78.4/100 points in the second trial. Once again, these results highlight that patients improve following surgery (and non-surgical treatment), but they are not fully recovered, as also shown by other studies (36, 37). The non-surgical treatment arm of the FASHIoN trial (34) has met with some concern regarding whether it meets the standard of current best practice for the exercise treatment of FAI syndrome (48). Some trials are on the way that may provide evidence confirming our criticism and supporting suggestions for change (48). While surgery can change morphology, it cannot address functional impairments of, for example, strength, single-leg balance, or functional performance that have been reported in FAI syndrome patients (17). Exercise treatment is the treatment best suited to address these impairments, so patients need rehabilitation not just as an alternative to surgical treatment but also after surgical treatment. Unfortunately, post-operative rehabilitation following hip arthroscopy is not well described in the current literature.

Rehabilitation following arthroscopic treatment of FAI syndrome

According to systematic reviews, post-operative rehabilitation can be roughly divided into four phases (49, 50). The primary aims of the first phase are protection, early regaining of ROM, and abdominopelvic muscle control. Immediate weight bearing on crutches is permitted as tolerated. Patients take non-steroidal anti-inflammatory drugs to prevent heterotrophic ossification (51) and are encouraged to perform circumduction movements to prevent intra-articular adhesions (52). In phase two, patients are expected to return to pain-free ambulation and basic ADL function while strengthening of the core and hip muscles is initiated. Due to the irritability of the iliopsoas muscle, hip flexion exercises are performed with caution. In phase three, strength training progresses and, besides endurance training, patients also start to perform more sport-specific rehabilitation before they gently are returned to sport in the fourth and last phase. Existing protocols are often time and criteria based, but progression criteria vary between protocols (53-56). Permission to engage in high-impact activities and RTS is usually given three months following surgery at the earliest.

Non-surgical treatment of FAI syndrome

When my PhD project was initiated, a systematic review highlighted that non-surgical treatment of FAI syndrome is promoted as the initial treatment, but that this approach lacks evidence supporting its effectiveness (57). Commonly, non-surgical treatment was labeled "trial of conservative care," indicating that surgery was the better option waiting down the line. Today, we have evidence from randomized controlled trials showing that non-surgical care is an effective treatment option for patients with FAI syndrome (34, 35, 46). In the Warwick Agreement, non-surgical treatment of FAI syndrome is divided into conservative care and physiotherapist-led rehabilitation (1). Besides prescribing and delivering analgesic drugs, physiotherapists usually deliver all treatment elements included in the umbrella term "conservative care." These treatment elements include activity modification and patient education, which in my opinion are active elements of treatment and therefore not well described by the term "conservative." Physiotherapist-led treatment includes impairment-based interventions, mainly delivered through exercise, and is recommended to be performed for at least three months (58). There is ongoing debate regarding whether the non-surgical treatment arms of the existing randomized controlled trials represent optimal non-surgical care (48). However, the responsibility to develop, test, and implement high quality non-surgical exercise interventions for FAI syndrome lies with us as rehabilitation specialists.

Measuring outcomes of treatment for FAI syndrome

The outcome of treatment for FAI syndrome can be evaluated in terms of patient-reported outcome measures (PROMs) and clinical outcome measures such as ROM, muscle strength, and functional performance-based measures (PBMs) (59, 60). Since patients with FAI syndrome often choose to undergo hip arthroscopy in order to RTS (61), RTS occupies a central position in this thesis and outcomes are evaluated in its context.

Patient-reported outcome measures

According to the International Classification of Functioning, Disability and Health (ICF), dysfunction is defined as limitations on the following three levels: impairments, activity limitations, and restrictions on participation (62). PROMs can capture all these domains and are often constructed around the aim of doing so. The Copenhagen Hip and Groin Outcome Score (HAGOS) and the International Hip and Groin Outcome Score (iHOT) are considered the most appropriate PROMs for the evaluation of patients undergoing hip arthroscopy for FAI syndrome (1, 59, 63).

HAGOS

The HAGOS is a valid and reliable assessment tool for young to middle-aged patients with hip and groin pain. In total, HAGOS consists of 37 questions evaluating hip-related function across six subscales: Symptoms, Pain, Function in Activity of Daily Living, Function during Sports and Recreation, Participation in Physical Activities, and Quality of Life (64). Responses are given on an ordinal scale ranging from 0 to 4, with 0 indicating no problems and 4 indicating maximal problems. Total scores for each subscale are then presented ranging from 0 (worst possible function) to 100 (best possible function).

iHOT

For use in clinical practice, the original version of iHOT with 33 questions (iHOT33) has been reduced to a shorter version with only 12 items (iHOT12) (65, 66). Both versions are valid and reliable in the assessment of hip-related quality of life in active patients with hip pathology. Patients are asked to rate their impairments on visual analogue scales ranging from 0 (representing significant impairment) to 100 (representing no impairments at all), and an average score is computed as the final result.

Hip Sport Activity Scale (HSAS)

For the measurement of activity level in patients with hip pathology, HSAS can be used as a valid and reliable PROM (67). HSAS was developed specifically for use in patients with FAI syndrome and categorizes activity level on an ordinal scale ranging from 0 (sports with least assumed impact on the hip joint) to 8 (sports with highest assumed impact on hip joint). Patients are asked to rate their activity level when they were young, before the onset of symptoms, and at the moment of completion.

Range of motion and muscle strength

Despite conflicting evidence as to whether ROM is impaired in patients with FAI syndrome compared with healthy individuals (17), it is considered one of the clinical signs associated with the diagnosis (1). ROM is recommended to be clinically measured with a goniometer or inclinometer (60). Hip ROM can be reliably measured with adequate testing protocols, but may overestimate total range due to the challenge of controlling for movements of the pelvis and the lower back (68). Hip muscle strength can be expected to be impaired in patients with FAI syndrome (17, 69), and as one of the factors that can be modified during rehabilitation it should be assessed clinically (60). Hip muscle strength can be reliably assessed using a handheld dynamometer and established testing protocols (70).

Performance-based measures

Performance-based measures (PBMs), such as hop, balance, or change of direction tests, are intended to reflect patients' athletic requirements and can be assessed clinically (71). PBMs are recommended for use in the rehabilitation process following hip arthroscopy for FAI syndrome to monitor progression and athletic abilities required to RTS (72). We currently have very little evidence for the validity of PBMs in evaluating rehabilitation progression, especially regarding RTS in patients with hip complaints (73, 74). Due to this knowledge gap, it is currently recommended that readiness to RTS be evaluated by testing the ability to perform sport-specific activities that match the demands of the sport to which the patient wants to return (60).

Return to sport

Patients with FAI syndrome often decide to undergo arthroscopic treatment to RTS (75), and fulfillment of the expectation to RTS can predict satisfaction with the outcome (61). RTS is an outcome that matters to patients and therefore should be assessed adequately. Although RTS is reportedly high following HA (72), it is often reported in a binary fashion. Consensus recommendations advocate assessing RTS on a continuum ranging from a) return to sport participation, through b) return to sport, to c) return to previous performance level (76) (Figure 4). Whether or not an athlete is ready to RTS may depend on both physical and psychological factors (77). Clinicians should therefore consider both physical and psychological recovery from surgery when evaluating readiness to RTS (60).

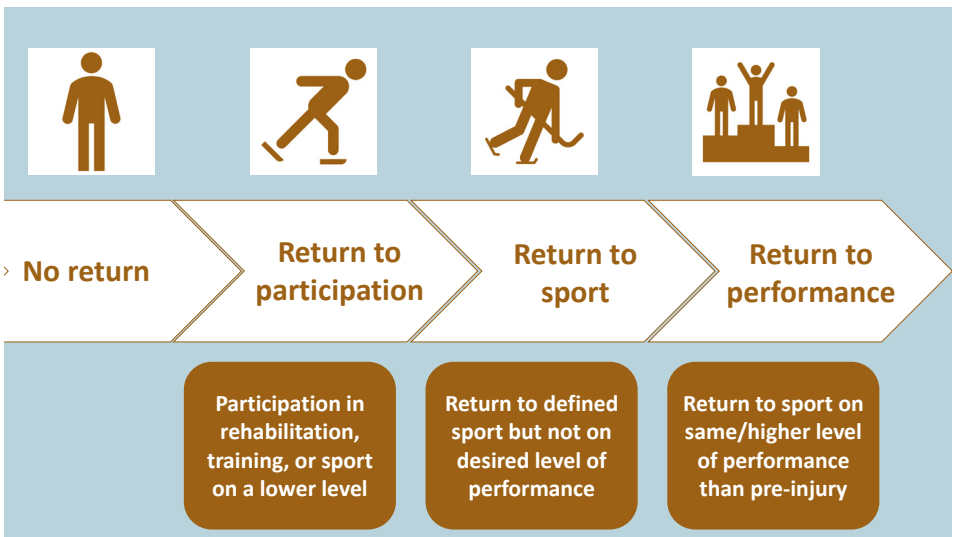


Figure 4: Return to sport continuum (modified from Ardern et al. (76)).

Rationale for the PhD project

As a clinician involved in the rehabilitation of patients with FAI syndrome following hip arthroscopy, I had my formerly limited experience and published expert opinions to rely on when treating these patients. While the number of patients requiring rehabilitation was increasing, there was a paucity of evidence regarding how to rehabilitate them. In the absence of clinical consensus or evidence for certain rehabilitation practices, a description of current practices appeared to be a solid first step to build on. Therefore, we aimed to describe the rehabilitation following hip arthroscopy for FAI syndrome from the most important perspectives: those being rehabilitated (patients), those rehabilitating them (clinicians), and the clinical results (clinical outcomes).

Aims

The overarching aim of this project was to investigate the rehabilitation process following hip arthroscopy for FAI syndrome with regard to current clinical practice and outcomes related to RTS.

Individual study aims

In study 1, we aimed to provide an overview of the rehabilitation process following hip arthroscopy in Scandinavia. Current practice and perspectives regarding rehabilitation strategies among surgeons and physiotherapists providing specialized care in this field were described. Furthermore, potential differences in perspectives on the rehabilitation process between professions were explored.

In study 2, we aimed to describe RTS rates, defined as a continuum ranging from (a) no RTS or return to (b) a different sport or exercise than before hip symptoms, (c) the same sport or exercise as before hip symptoms at a lower performance level, or (d) the same sport or exercise as before hip symptoms at the same level of performance, in a group of previously sport- or exercise-active patients 3–36 months following hip arthroscopy for FAI syndrome. Second, we aimed to describe patient satisfaction with achieved RTS levels as well as patient-reported time to RTS, defined as return to same (i.e., pre-symptomatic) sport or exercise.

In study 3, we aimed to compare subjective and objective hip-related function, assessed in terms of patient-reported measures as well as objective measures such as ROM, strength, and PBMs, between patients 6–10 months after hip arthroscopy and asymptomatic controls. Furthermore, we aimed to compare the objective function of the operated hip with that of the non-operated hip in the hip arthroscopy patients.

In study 4, we aimed to modify the Swedish ACL-RSI (Hip-RSI) and validate it for the assessment of psychological readiness to RTS in patients following hip arthroscopy. We aimed to adapt the full 12-item scale to the target population by performing an item reduction and to describe the structural validity, internal consistency reliability, content validity, and construct validity of the full and the reduced-item scales. Associations between Hip-RSI scores and level of return to sport participation, previous sport, and sport performance following hip arthroscopy in patients with FAI syndrome further assessed the validity of the scale.

Methods

An overview of the methods used in the four included studies is provided in Table 1.

Study designs

Study 1

Cross-sectional online survey of clinicians (physiotherapists and orthopedic surgeons) experienced in the care of FAI syndrome patients (i.e., performance of hip arthroscopy and rehabilitation of patients following hip arthroscopy, respectively).

Study 2

Cross-sectional description of self-reported RTS rates (online survey) in patients who underwent hip arthroscopy for FAI syndrome 3–39 months previously.

Study 3

Cross-sectional comparison of hip function (self-reported and clinically measured) between patients who underwent hip arthroscopy for FAI syndrome 6–10 months previously and a healthy control group.

Study 4

Psychometric study modifying and evaluating properties of a self-reported outcome score intended to evaluate psychological readiness to RTS in patients treated for FAI syndrome through hip arthroscopy.

Table 1:
Overview of methods.

	Study 1	Study 2	Study 3	Study 4
Aim	Describe current clinical practice in rehabilitation following HA in Scandinavia Explore differences between experiences/perspectives of surgeons and physiotherapists	Describe RTS rates following HA according to the RTS continuum and describe patient satisfaction with achieved RTS levels	Compare hip function of patients 6–10 months after HA with that of healthy controls Compare function of the operated hip with that of the contralateral hip	Assess psychometric properties of the Swedish version of a hip-modified ACL RSI (Hip-RSI) and describe psychological readiness to RTS in patients following HA
Design	Cross-sectional survey	Cross-sectional survey	Cross-sectional study	Psychometric study
Sample	Clinicians (28 orthopedic surgeons, 62 physiotherapists) experienced in treating patients with FAI syndrome	127 patients 3–39 months following HA for FAI syndrome	33 patients 6–10 months following HA for FAI syndrome and 33 healthy controls	127 patients 3–39 months following HA for FAI syndrome and 55 experts (35 patients, 11 physiotherapists, and 9 orthopedic surgeons)
Data collection	Online survey assessing perceived value of physiotherapy, progression criteria, outcome evaluation strategies, and expected time frames	Online survey assessing RTS rates (no return, return to participation, return to same sport, return to previous performance level) and satisfaction with achieved RTS level	Self-reported outcome: HAGOS Clinical outcomes: muscle strength, ROM Performance outcomes: YBT, THT, IAT	Online survey assessing Hip-RSI, RTS rates, HAGOS, and iHOT12 Online survey assessing item relevance of Hip-RSI
Statistics				

ACL/Hip-RSI = Anterior Cruciate Ligament/Hip Return to Sport after Injury Scale; FAI = Femoroacetabular impingement syndrome; HA = hip arthroscopy; HAGOS = Hip and Groin Outcome Score; IAT = Illinois Agility Test; RTS = Return to sports; ROM = Range of motion; THT = Medial/Lateral Triple Hop Test; YBT = Y-Balance Test.

Participants

The included samples consist of specialized healthcare practitioners (study 1) and patients with FAI syndrome treated through hip arthroscopy (studies 2–4). Study 3 also included a control group of participants without hip complaints who were matched to patients in terms of age, sex, and activity level. All patients included in the studies were operated on at Capio Artro Clinic and form a homogeneous group in terms of surgical indication and treatment. Cam resection was the predominant treatment performed (in 98–100% of cases), while pincer resection was performed less frequently and only in combination with cam resection (13–18%). Most patients were male (75–96%) and acetabular cartilage defects were present in 78–82%. The following sections present the participants' most important characteristics, which are presented in detail in studies 1-4.

Study 1

To describe current clinical rehabilitation practice following hip arthroscopy in the treatment of FAI syndrome in Scandinavia, we recruited physiotherapists and orthopedic surgeons from Denmark, Norway, and Sweden. Surgeons were recruited via the member lists of Scandinavian meetings of hip arthroscopists, and the scope was broadened by contacting surgical departments and clinics reporting data to the Scandinavian ACL registries. Physical therapists, experienced in the rehabilitation of hip arthroscopy patients, were recruited via national sports medicine associations, surgical referral patterns, and social media. Information regarding the 90 included clinicians is provided in Table 2.

Table 2:
Characteristics of participants in study 1.

	Physiotherapists (*n* = 62)	**Orthopedic surgeons (*n* = 28)**
Country, % (*n*)		
Denmark	37.1 (23)	42.9 (12)
Norway	6.5 (4)	21.4 (6)
Sweden	56.5 (35)	35.7 (10)
Sex, % (*n*)		
Female	40.3 (25)	-
Male	59.7 (37)	100 (28)
Experience in treating HA patients, years		
Mean (SD)	5.6 (3.42)	8.4 (6.05)
Median (IQR)	5 (3–8)	6.5 (4–11.75)
HA patients per year		
Mean (SD)	14.5 (22.41)	67.0 (55.03)
Median (IQR)	5 (3–15)	40 (30–108.75)

n = Number of respondents; HA = Hip arthroscopy; SD = Standard deviation; IQR = Interquartile range.

Study 2

We searched the patient database at Capio Artro Clinic for patients who underwent hip arthroscopy between 2014 and 2016. We based patient selection on the following International Classification of Diseases—10th Revision treatment codes: labrum repair (NFT99), labrum resection (NFH91), rim trimming (NEK19), and cam resection (NFK19). We applied the following inclusion criteria: (a) ≥18 years of age; (b) hip arthroscopy for FAI syndrome (cam resection, pincer resection, or combination) three or more months before data collection; (c) participation in sports/exercise (Hip Sports Activity Scale [HSAS] ≥ 1] before surgery; and (d) no other surgery following the indexed arthroscopy. The patient flow into the study is summarized in Figure 5 and the patient information is summarized in Table 3.

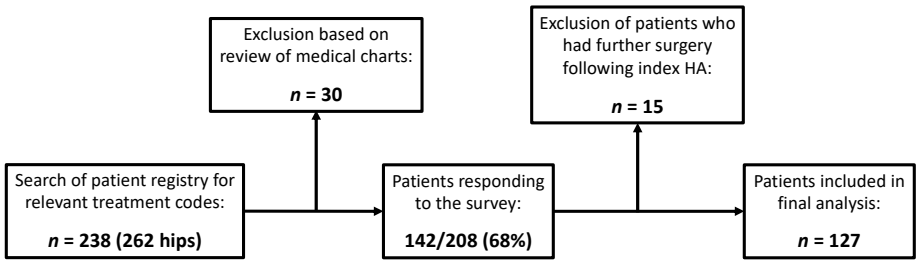


Figure 5: Flow of patients into study 2.

Table 3: Characteristics of participants in study 2.

Age, years Mean (SD), range	34.3 (10.1) 17–60
Sex, % (*n*) Female Male	 24.4 (31) 75.6 (96)
HSAS before symptoms (*n* = 126) Mean (SD) Median (IQR)	 5.5 (1.9) 5 (4–7)
Time from surgery to follow-up, months Mean (SD); range Median (IQR)	 19.4 (10.4); 3–39 18.3 (10.8–25.9)
n = Number of participants; SD = Standard deviation.	

Study 3

Similar to the recruitment of study 2, we identified patients from Capio Artro Clinic's patient database. We based patient selection on the following International Classification of Diseases—10th Revision treatment codes: labrum repair (NFT99), labrum resection (NFH91), rim trimming (NEK19), and cam resection (NFK19). We applied the following inclusion criteria: (a) primary hip arthroscopy for FAI syndrome 6–10 months before inclusion (February–November 2016; for bilaterally operated patients, the time interval was calculated from the most recent surgical procedure); (2) at least 18 years of age; and (3) lived in the greater Stockholm area. Thirty-five of the 47 patients we identified were included in the survey, but two of these patients eventually had to be excluded after thorough review of their medical charts (1 patient had hip dysplasia and one patient had only a diagnostic arthroscopy). We then recruited a control group consisting of 33 healthy, pain-free participants from local sport clubs, making an effort to match patients' sex, age, type of sports/physical activity, and respective levels of participation before hip symptoms according to the Hip Sports Activity Scale (HSAS). Inclusion criteria for

control participants were: (1) no history of hip surgery; (2) at least 18 years of age; and (3) no treatment for back pain and/or injuries in the lower extremities within the previous six months. Demographics of patients and control participants are summarized in Table 4.

Table 4: Characteristics of participants in study 3.

	Hip arthroscopy patients (*n* = 33)*	Control participants (*n* = 33)*
Age, years	32.3 ± 9.4	31.1 ± 10.6
Weight, kg	79.8 ± 9.0	79.0 ± 12.6
Height, cm	179.3 ± 7.1	179.5 ± 7.5
Sex, *n* (%)		
Female	4 (12.1)	4 (12.1)
Male	29 (87.9)	29 (87.9)
Time since surgery, months	8.1 ± 2.6	-
Arthroscopic procedure, *n* (%)		
Cam resection	33 (100)	-
Cam and pincer resection	6 (18.2)	-
Labrum trimming	31 (93.9)	-
Labrum repair	1 (3.0)	-
Training hours per week	6.9 ± 4.0	7.1 ± 4.5
HSAS score, median (IQR)		
Before symptoms	6.5 (3.5–7.0)	-
Currently	4.5 (3.0–5.8)	5.0 (3.0–7.0)

* Data reported as mean ± standard deviation unless otherwise indicated; HA = Hip arthroscopic surgery; HSAS = Hip Sports Activity Scale; IQR = Interquartile range.

Study 4

Study 4 included three groups of participants. The first group consisted of the patient sample described in study 2 ($n = 127$) and was used to evaluate the construct validity and item reduction of the Hip-RSI. The second group consisted of 35 patients who had undergone hip arthroscopy (mean time since surgery was 9 ± 5 months) and were identified in Capio Artro Clinic's patient registry, as described for studies 2 and 3. These patients were used as part of an expert panel to evaluate the content validity and item reduction of the Hip-RSI. The third group, which completed the expert panel, consisted of clinicians experienced in performing hip arthroscopy (orthopedic surgeons, $n = 9$) or rehabilitating patients following hip arthroscopy (physiotherapists, $n = 11$).

Data collection and outcome measures

Survey data

Online surveys were a primary data source in all four studies. We used Sunet Survey to create and administer our surveys.

In study 1, we created a survey based on the best available evidence at the time the study was planned and conducted (65, 66). Guided by identified knowledge gaps regarding the rehabilitation process following hip arthroscopy, we focused the survey content on: (a) the rehabilitation timeline; (b) recommended/applied rehabilitation guidelines, including progression criteria (time/outcome based); (c) utilization and choice of clinical outcome measures; and (d) specifics of treatment, such as treatment frequency and modalities. After pilot testing for face and content validity on a group of clinicians (orthopedic surgeons and physiotherapists), we then translated the survey into Danish, Norwegian, and Swedish. The Swedish version of the survey is presented in Appendix 1.

In studies 2–4, we collected patient characteristics, self-reported outcome measures (HSAS, iHOT12, HAGOS, and Hip-RSI), RTS status, and satisfaction with current RTS levels via online surveys. We assessed RTS by asking patients whether they had (a) not returned to sport, i.e., did not participate in any sport or exercise ("No sport") or returned to (b) general participation in a different sport or exercise compared with before hip symptoms ("Different sport"); (c) participation in the same sport or exercise as before hip symptoms but on a lower performance level ("Same sport, lower performance"); or (d) participation in same sport or exercise on same or higher performance level than before hip symptoms ("Same sport, same performance"). Furthermore, we asked patients to report satisfaction with their current level of sports activity (binary response, yes/no) and to report the time from hip arthroscopy to RTS (months). Full versions of the surveys can be found in Appendix 2-4.

Clinically measured hip function and performance outcomes

In study 3 we also measured hip function clinically according to a standardized protocol (see Appendix 5). We measured hip ROM (flexion, internal rotation, and external rotation) with a goniometer and an inclinometer. Hip muscle force (adduction, abduction, flexion, extension, internal rotation, and external rotation) was measured with a handheld dynamometer (Figure 6). Participants also underwent a battery of performance tests assessing: combined ROM, flexibility, and balance using the Y-Balance Test; hop performance using the Medial/Lateral Triple Hop Test; and maximal acceleration, deceleration, sudden change of direction, and nonlinear running using the Illinois Agility Test (Figure 7).

Figure 6: Hip muscle force testing with handheld dynamometer: A) hip adduction, B) hip external rotation, C) hip flexion, D) hip abduction, E) hip internal rotation, and F) hip extension.

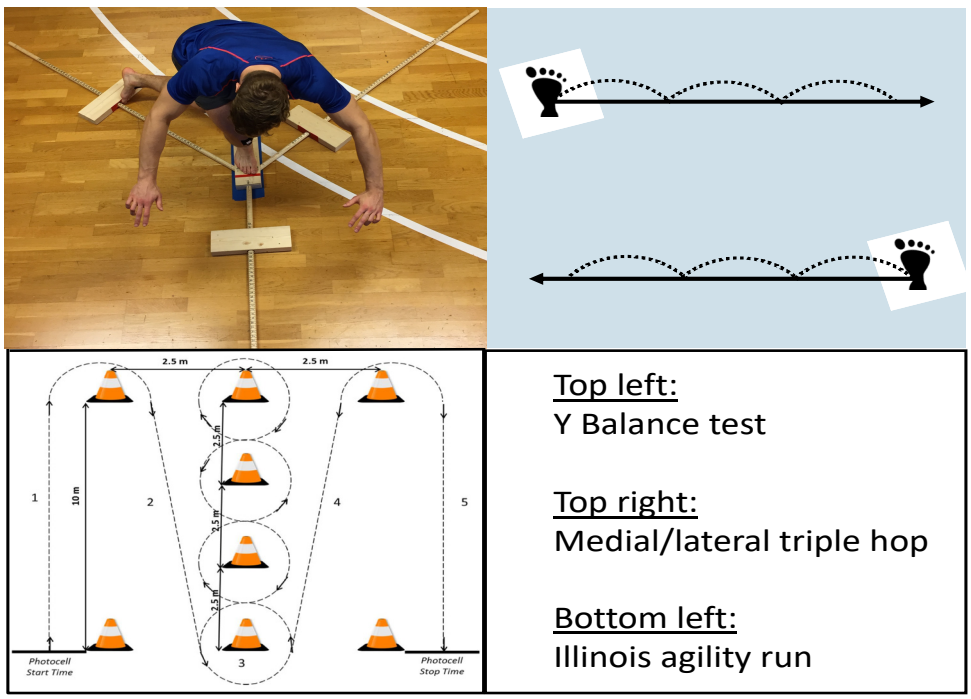


Figure 7: Performance-based measures.

Statistical methods

All analyses were performed using SPSS Statistics versions 23–26 (IBM Corp., Armonk, NY).

We presented descriptive statistics in the form of means and standard deviations for normally distributed numerical data. Non-normally distributed numerical or ordinal data were presented as medians and interquartile ranges. Nominal data were presented as percentages and frequencies. In study 1, we dichotomized ordinal variables to allow for more interpretable group comparisons. In study 4, we assessed the central tendencies of participants' Hip-RSI item scores, mean relevance scores, and the proportion of experts rating each item as relevant, as a step toward removing redundant items from the scale (67–69).

Studies 1–3 were explorative in nature and no a priori directed hypotheses were formulated. In study 4, we evaluated the construct validity of the Hip-RSI and therefore formulated an a priori hypothesis about the strength of association ($r > 0.5$) between Hip-RSI and HAGOS Sport as well as iHOT12.

Group differences for categorical and non-normally distributed numeric data were analyzed using Chi-square and Mann–Whitney U tests, respectively. Group differences for between-group comparisons of normally distributed data were analyzed using independent-sample *t*-tests (two groups; independent-sample testing for different groups and paired-sample testing for between-limb comparisons) or analysis of variance (ANOVA) with post hoc pairwise comparison for comparisons of more than two groups. Using parametric tests, group differences were presented as mean differences with accompanying 95% confidence intervals (CIs). In study 3, we presented group differences as absolute differences (mean differences with 95% CIs) but also as standardized effect sizes (Cohen's *d* with accompanying 95% CIs), considering effect sizes of 0.2 as small, 0.5 as medium, and 0.8 as large (70).

In study 4, psychometric properties of the reduced and full scales were examined. As the underlying data were normally distributed, we analyzed the association between Hip-RSI and HAGOS Sport as well as iHOT12 using Pearson correlation and presented the correlation coefficient (*r*) with accompanying 95% CIs. We computed Cronbach's alpha as a measure of internal consistency and performed a confirmatory factor analysis to examine the factorial structure of the scales. The alpha level was set to 0.05 in all studies.

Sample size estimations

Due to the generally descriptive nature of studies 1 and 2, we did not estimate the sample size before data collection. In study 3, we based our sample size estimation

on a minimal detectable difference of 10% in performance measures (corresponding to Cohen's *d* of 0.7–0.9), an alpha level of 0.05, and 80% power.

Ethical considerations

Studies 2–4 were approved by the Ethics Committee at Lund University (DNR: 2016/1068, DNR: 2016/472, DNR: 2019/03225). Study 1 did not require formal ethical approval since the data were collected anonymously, we did not handle any personal information or sensitive data, and the study involved no physical engagement or measures that in any way could have affected participants. All participants provided informed consent before inclusion in the studies.

Results

Study 1

Physiotherapists and orthopedic surgeons rated physiotherapy as very or extremely important (92% [57/62] and 82.1% [23/28], respectively) in rehabilitation following hip arthroscopy. Nearly all surgeons (96.4% [27/28]) always referred their patients to a physiotherapist for treatment. Participants followed (physiotherapists: 83.9% [52/62]) or recommended (surgeons: 75% [21/28]) either criteria-based or combined criteria- and time-based rehabilitation progression, with exercise-based treatment rated as the most important component (94.4% [88/90]). More than 90% of the participants reported using patient-reported outcomes and clinically measured outcomes at least "sometimes" or "always." However, surgeons reported more frequently using patient-reported outcomes, while physiotherapists reported more frequently using performance-based measures (Figure 8) and evaluating RTS (physiotherapists: 74.2% [46/62]; surgeons: 50% [14/28]; $p = .024$).

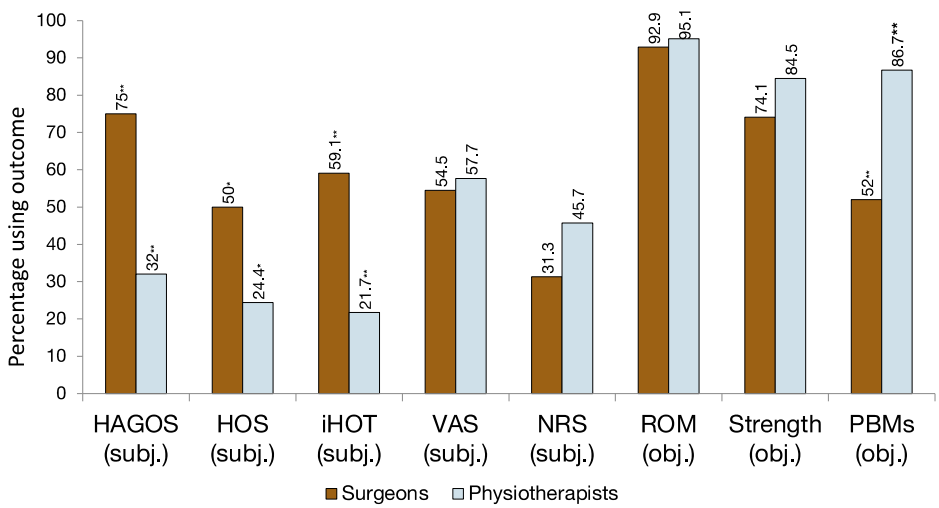


Figure 8: Reported use of outcome measures by profession: HAGOS = Copenhagen Hip and Groin Outcome Score; HOS = Hip Outcome Score; iHOT = International Hip Outcome Tool; VAS = Visual analog scale; NRS = Numeric rating scale; PBM = Performance-based measure; subj. = subjective; obj. = objective; * Between-group comparison *p*-value ≤ 0.05; ** *p*-value ≤ 0.01.

Generally, surgeons and physiotherapists expressed similar views regarding the estimated rehabilitation timeline. Variations in responses regarding expected timeframes for different rehabilitation milestones increased with increasing time from surgery and approach to RTS (Figure 9). Surgeons were more optimistic than physiotherapists regarding the expected time on crutches: median (IQR) maximal number of weeks on crutches—physiotherapists = 6 (4–7.5), surgeons = 4 (3–6), p = 0.025; median (IQR) average number of weeks on crutches—physiotherapists = 4 (2–4), surgeons = 2 (2–3), p = 0.022, and regarding the expected minimal time to return to competitive sports: median (IQR) maximal number of weeks—physiotherapists = 18 (12–24), surgeons = 12 (12–20), p = 0.011.

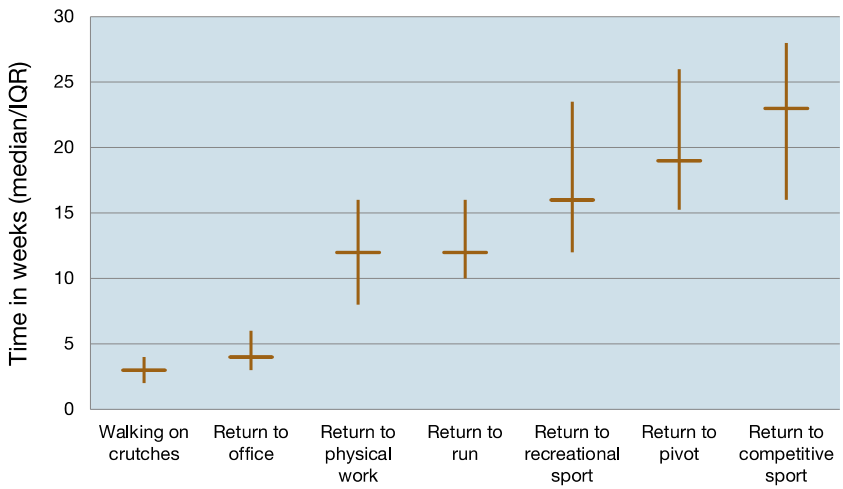


Figure 9: Expected rehabilitation timeline.

The RTS decision was reportedly made through shared decision making in which patients had the highest influence, followed by physiotherapists and surgeons. The most influential factor in the RTS decision was rated to be pain (Figure 10). Physiotherapists more often than surgeons rated strength (physiotherapists, 88.9%; surgeons, 46.3%; p = 0.003) and performance-based measures (physiotherapists, 84.8%; surgeons, 46.2%; p = 0.008) to be influential in the RTS decision.

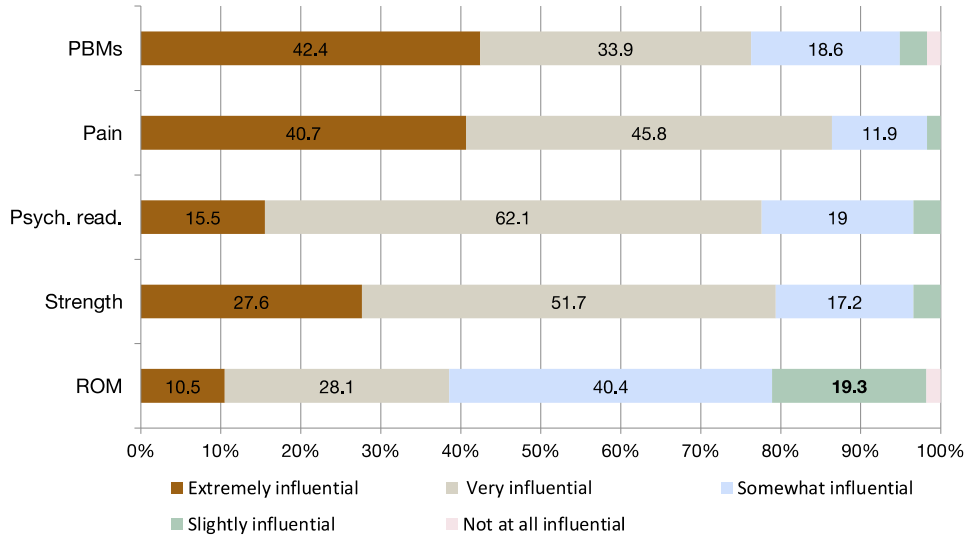


Figure 10: Factors influencing the return to sport decision.

Study 2

Patients (*n* = 127) responded to the survey at a mean time of 19.4 months (SD, 10.4; range, 3–39) and reported a mean time to RTS of 8.1 (±3.8) months. Patients returned to activity levels that had decreased by two points on the HSAS (median [IQR]: 3.5 [2–5]) compared with the pre-symptomatic activity levels. Of all patients, 11% (*n* = 14) had not returned to any sport or physical activity and the remaining 89% (*n* = 113) had returned to some kind of sport or physical activity. Of patients who had returned to sport, 39.4% (*n* = 50) returned to different sports or activities compared with before the surgery, 28.3% (*n* = 36) returned to the same sport as before the surgery, and 21.3% (*n* = 27) returned to previous performance levels (Figure 11). Over six months post hip arthroscopy, about half of patients (46.4% [95% CI 37–56%]) reported being satisfied with current activity levels (Table 5). Higher proportions of satisfied patients were observed in groups with higher levels of sport or exercise participation. The only group with more satisfied than dissatisfied patients was the group that had returned to the same or higher level of performance.

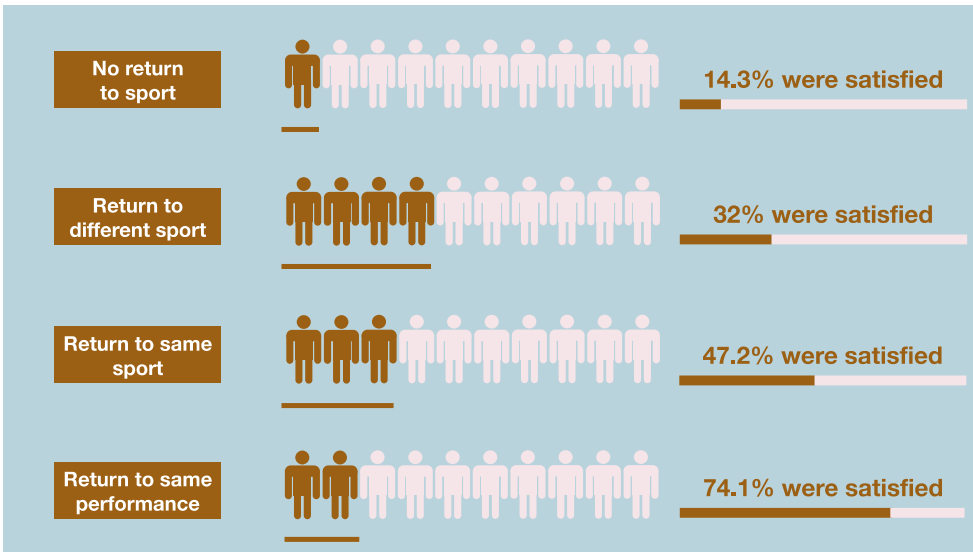


Figure 11: Return to sport rates 3–39 months following hip arthroscopy.

Table 5: Return to sport rates at different time points.

	Stratification according to time since surgery in months					
Achieved level of return, % (*n*)	>3–39 (*n* = 127)	>3–6 (*n* = 15)	>6–12 (*n* = 24)	>12–18 (*n* = 23)	>18–24 (*n* = 15)	>24–39 (*n* = 50)
No return to sport/exercise	11 (14)	23.1 (3)	4.2 (1)	4.3 (1)	-	18 (9)
Return to diff. sport/exercise	39.4 (50)	38.5 (6)	37.2 (9)	43.5 (10)	33.3 (5)	40 (20)
Return to same sport at lower performance level	28.3 (36)	30.8 (5)	29.2 (7)	26.1 (6)	33.3 (5)	26 (13)
Return to same sport at same performance level	21.3 (27)	7.7 (1)	29.2 (7)	26.1 (6)	33.3 (5)	16 (8)

Study 3

At a follow-up time of 6–10 months following hip arthroscopy, patients reported significantly worse function on the HAGOS than did a healthy control group (Figure 12). We found large effect sizes for all subscales, but most markedly for the subscales Sports and Participation, Physical Activities, and Quality of Life (see Table 6). For clinically measured hip function, we found small effect sizes indicating generally reduced function in patients compared with controls, but no similar clear pattern between the surgically treated and the contralateral hip (Figures

11 and 12). Differences between patients and controls were only statistically significant for measures related to FAI-specific ROM impairments (ROM, flexion strength, and posteromedial reach in the YBT).

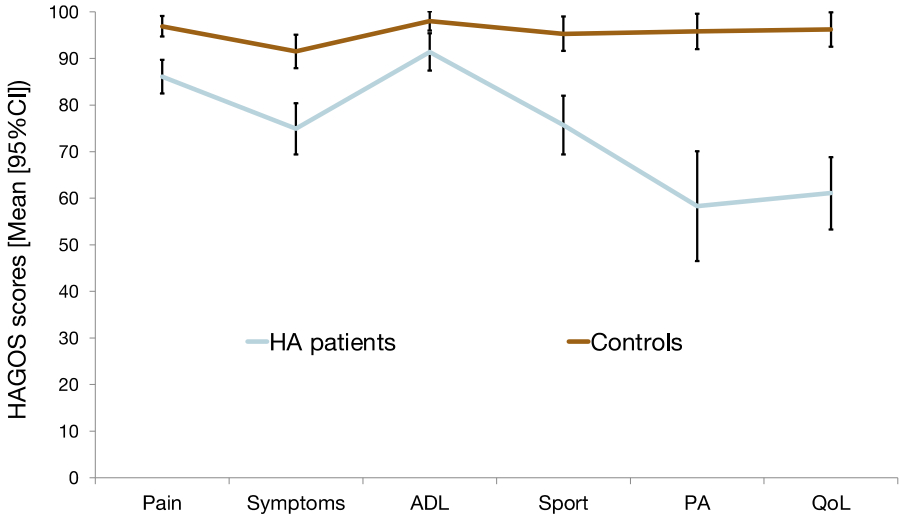


Figure 12: Self-reported function in hip arthroscopy patients and control participants.

Table 6: Self-reported function (HAGOS) for hip arthroscopy patients and controls.

HAGOS subscale	HA (*n* = 33)	Controls (*n* = 33)	MD (95% CI)	*p*-value	Cohen's *d*
Pain	86.1 (10.1)	96.9 (6.3)	–10.8 (–14.9 to –6.6)	<.001	–1.3 (–0.7 to –1.8)
Symptoms	74.9 (15.5)	91.5 (10.1)	–16.6 (–23.0 to –10.1)	<.001	–1.3 (–0.7 to –1.8)
ADL	91.4 (11.3)	98.0 (6.0)	–6.7 (–11.1 to –2.2)	.004	–0.7 (–0.2 to –1.2)
Sport	75.7 (17.7)	95.3 (10.4)	–19.6 (–26.8 to –12.4)	<.001	–1.4 (–0.8 to –1.9)
PA	58.3 (33.5)	95.8 (10.7)	–37.5 (–49.9 to –25.1)	<.001	–1.5 (–1.0 to –2.1)
QoL	61.1 (22)	96.2 (10.5)	–35.2 (–43.7 to –26.6)	<.001	–2.1 (–1.4 to –2.6)

ADL = Activities of daily living; HA = Hip arthroscopy; HAGOS = Hip and Groin Outcome Score; MD = Mean difference; PA = Physical activity; QoL = Quality of Life.

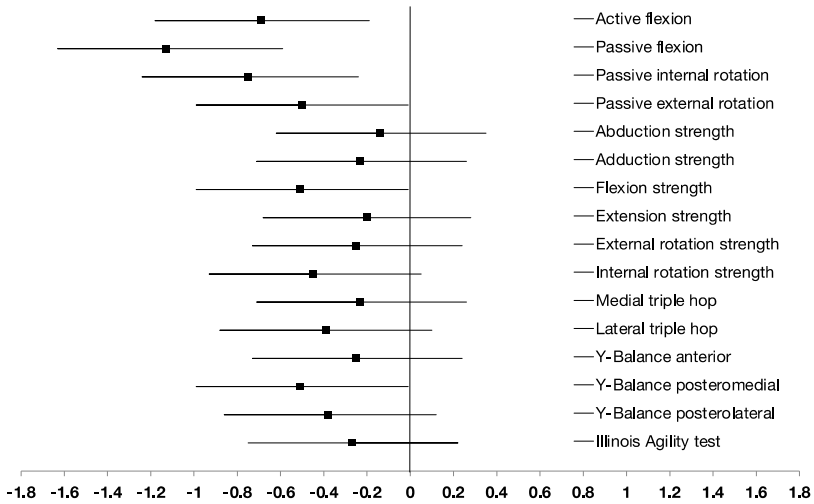


Figure 13: Standardized effect sizes (Cohen's *d* [95% CI]) of group differences in clinically measured outcomes between hip arthroscopy patients and control participants. Negative effect sizes indicate inferior results in hip arthroscopy patients.

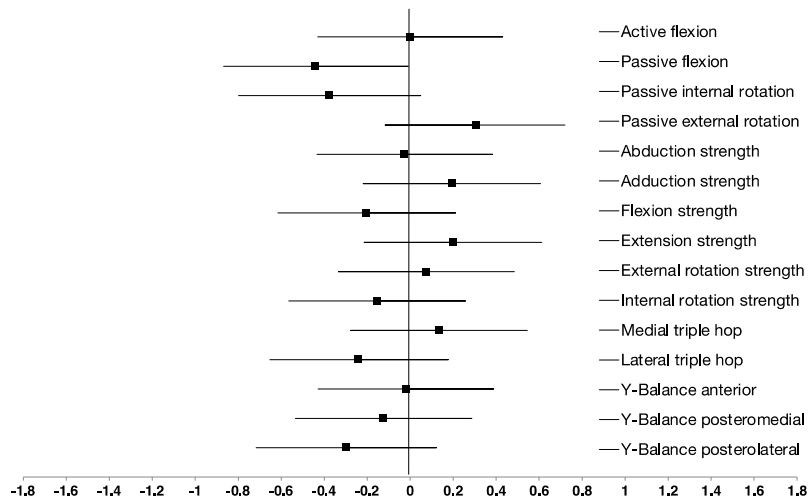


Figure 14: Standardized effect sizes (Cohen's *d* [95% CI]) of side-to-side differences in clinical measures in hip arthroscopy patients. Negative effect sizes indicate inferior results on the surgically treated side.

Study 4

Based on patients' responses and expert ratings of item relevance, six items were omitted from the 12-item Hip-RSI scale due to low face validity for the assessment of patients following hip arthroscopy. The final, six-question version of the Hip-RSI is shown in Figure 15.

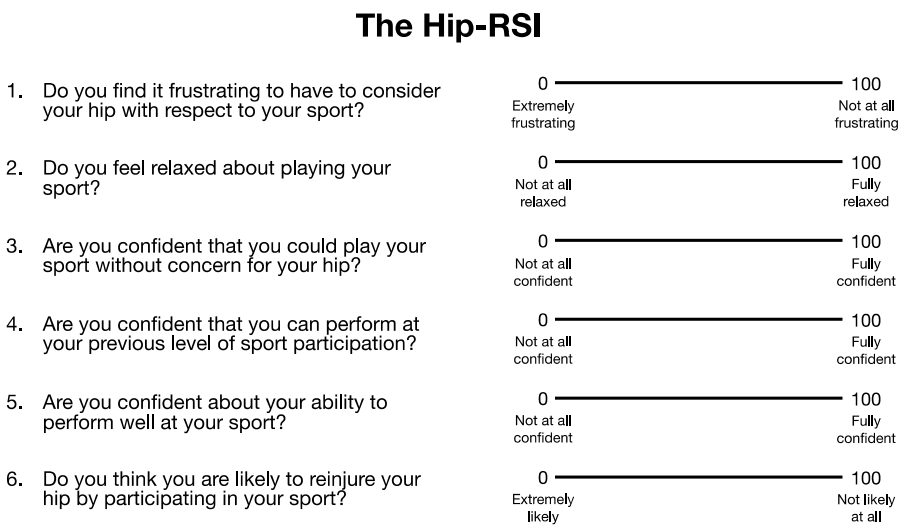


Figure 15: The short version of the Hip-RSI.

Psychometric properties of the Hip-RSI (short version)

Principal component factor analysis identified a single underlying factor accounting for 67.7% of the total variance (eigenvalue 8.1) for the full 12-item scale and 67.7% of the total variance (eigenvalue 4.1) for the six-item scale. The Cronbach's alpha was 0.96 for the full 12-item scale and 0.90 for the six-item scale. No floor or ceiling effects were observed (full scale: minimum score 1.4%, maximum score 1.4%; reduced-item scale: minimum score 1.4%, maximum score 4.9%). Our a priori hypothesis regarding the scale's construct validity, indicated by a correlation coefficient of >0.5, was confirmed. Pearson correlations (95% CIs) between the full and short forms of the Hip-RSI and HAGOS Sport were 0.69 (0.66–0.96) and 0.63 (0.56–0.87), respectively. Pearson correlations (95% CIs) between the full and short forms of the Hip-RSI and iHOT12 were 0.75 (0.78–1.07) and 0.73 (0.72–1.01), respectively (Figure 16).

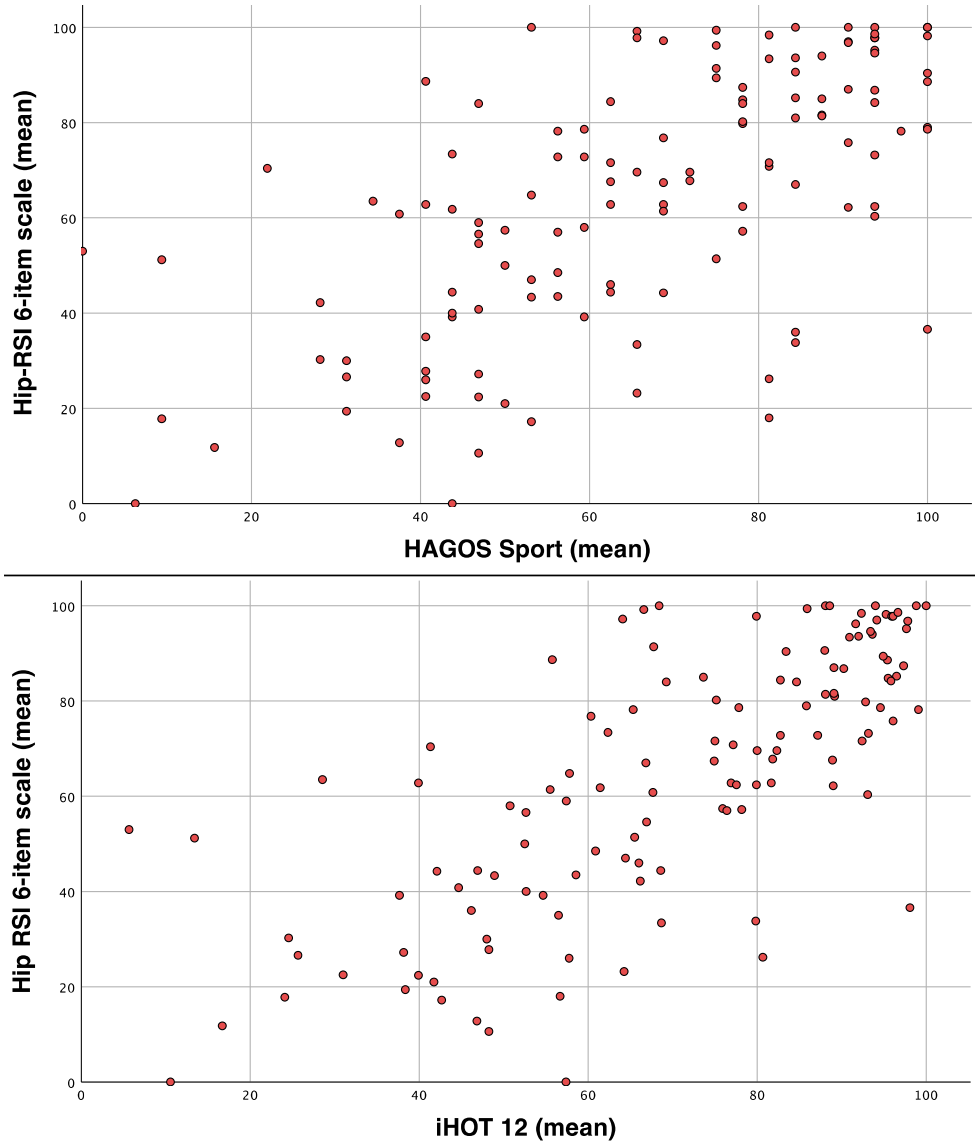


Figure 16: Correlations between the six-item Hip-RSI and HAGOS Sport (upper panel) and iHOT 12 (lower panel).

Associations with return to sport

We found higher Hip-RSI scores with increasing levels of RTS (Figure 17). The Hip-RSI scores of the RTS groups differed significantly from each other (mean differences, 18.6–54.8; $p \leq 0.001$), except among patients who reported return to a

different sport and patients who reported return to the same sport at a lower performance level (mean differences [95% CI]: 6.9 [–6.2 to 20.0]; $p = 0.515$).

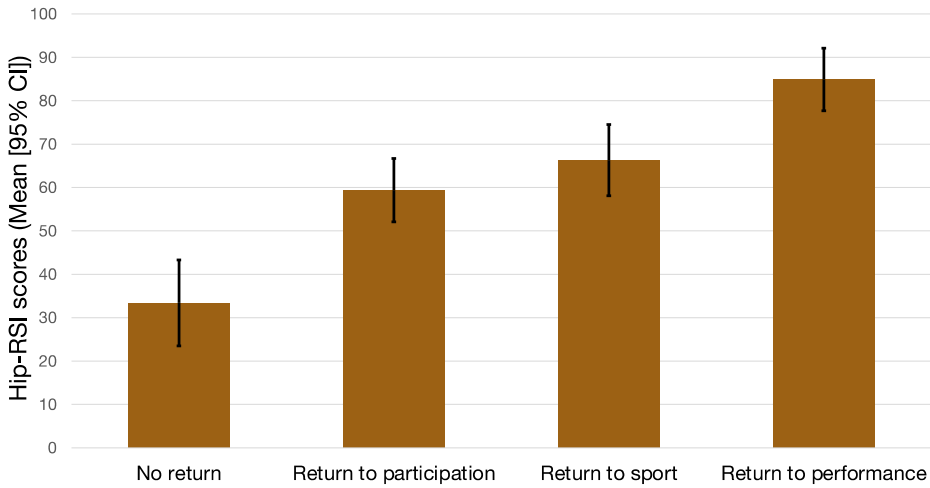


Figure 17: Hip-RSI (short version) scores for patients at different levels of return to sport.

Discussion

I started my PhD journey in 2015, at a time when the number of hip arthroscopies in Sweden was at its peak (44). As a clinician I experienced the lack of evidence regarding rehabilitation practice (49, 50), limiting my aim of providing the best possible treatment to my patients. Most of my patients are athletes and RTS is their most important treatment goal, but I saw a big discrepancy between RTS rates observed in the clinic and those described in the literature (72). The overarching aim of my thesis was to investigate the rehabilitation process following hip arthroscopy for FAI syndrome regarding current clinical practice, with a special focus on outcomes related to RTS. This research project was thus a deep dive into personally relevant clinical questions, but I hope that its results have provided insights for clinicians working with FAI syndrome patients treated with hip arthroscopy.

Summary of main findings

In Scandinavia, rehabilitation following hip arthroscopy for FAI syndrome is physiotherapist-led, structured rehabilitation mainly based on exercise therapy. During the first three months following surgery, clinicians reported quite similar expectations regarding the rehabilitation timeline, but the closer patients came to their RTS, the more variation was observed in their expectations. Compared with physiotherapists, surgeons were more optimistic regarding time on crutches and time to RTS (78). While nine out of ten patients returned to some kind of sport, approximately half of all patients returned to their previous sport and only one in five returned to their previous performance level. Satisfaction was highest in patients who returned to their previous performance level (79). While subjective function differed significantly between patients and healthy controls, clinically measured function did not explain the perceived impairments or low RTS rates. Clinical measures related to diagnosis-specific ROM impairments were worse in patients than healthy controls, but the effect sizes for these differences were small (80). The Hip-RSI displayed construct and content validity for the assessment of readiness to RTS in patients treated arthroscopically for FAI syndrome. Psychological readiness is higher in patients who have achieved higher RTS levels (81).

From biological healing times to clinical uncertainty

In 2015, when my PhD journey began, we had very little information on how to rehabilitate patients following hip arthroscopy (49, 50). The level of evidence of available peer-reviewed information for rehabilitation specialists was low. Most of the published papers were based on expert opinion, which is considered the lowest-quality evidence. Being ranked lower in quality than other types of evidence, however, does not mean that expert opinion is of no value. When we know very little about certain patients, and higher-quality evidence is lacking, published recommendations based on the experiences of clinicians who have treated large numbers of these patients are invaluable.

We found that clinicians' expectations regarding the rehabilitation timeline were quite similar during the first part (i.e., first 12 weeks) of rehabilitation, but that the range of expectations increased the closer the patient came to RTS, which could be interpreted as growing clinical uncertainty (study 1). Early descriptions of rehabilitation following hip arthroscopy are often structured around a perspective based on the structural changes induced during arthroscopy and associated biological healing times (54, 82, 83). Typically, these rehabilitation strategies involve four phases during the first three to four months following surgery (49, 50). During the first three phases, the rehabilitation timeline is clear, and clinicians can rely on expected biological healing times. In contrast to these first three phases, the final phase of rehabilitation, often called the RTS phase and initiated 12 weeks following surgery, is usually described very generically. Existing RTS protocols are reported with great variability and are not validated (74). Thus, when clinicians seek guidance on rehabilitation after hip arthroscopy in the existing literature, they will find standardized descriptions of care in the first three months following surgery. They will find these standardized rehabilitation strategies to be validated in terms of biological healing times and the protection of surgically treated tissues. When entering the RTS phase, the same clinicians will find variability instead of standardization, and clinical recommendations based on experience rather than validation. Hence, the increasing clinical uncertainty regarding the rehabilitation timeline observed in our survey is mirrored by increasing uncertainty in the existing literature.

Time plays an important role in structuring a rehabilitation protocol following surgery, but recovery of function may follow a different schedule and should be assessed in the process. Most clinicians we surveyed recommended a combination of time- and criteria-based progression during the rehabilitation of hip arthroscopy patients. Criteria-based rehabilitation had already been advocated at the time the study was performed (53-56) and is a cornerstone in more recent publications about rehabilitation after hip arthroscopy (84, 85). During the first phases of rehabilitation, when patients are returning to normal ADL function, progression criteria may be related to the ability to bear weight or walk and stand without compensation (49, 50,

84). Such criteria are directly related to the functional progression next in line and are thereby directly validated. Other progression criteria such as hip ROM and hip muscle strength are often compared with the non-operated side with the goal of achieving symmetry. Past the three-month boundary, when progression shifts its aim from return to ADL to RTS, we can find published progression criteria, but they lack validation (74). Different protocols recommend different functional parameters during RTS testing, and we do not know how these parameters relate to RTS. Thus, the clinical uncertainty regarding the rehabilitation timeline in the RTS phase is likely accentuated by the lack of validated progression criteria and clinical guidelines.

Physiotherapists are the clinicians involved in active rehabilitation and who witness the patients' progress in their regular meetings. As our survey showed, physiotherapists use performance-based measures and regular clinical measures of hip function more frequently than do surgeons, who more often use patient-reported outcomes to assess treatment effects. Patient-reported outcome measures such as HAGOS or iHOT are recommended in the assessment of treatment efficacy after hip arthroscopy and post-operative rehabilitation (63). Hence, physiotherapists would gain an important perspective on patients' progression over longer periods of time by using these evidence-based tools more frequently. At the same time, our regular assessment of hip function provides us with up-to-date insights into the patient's clinical function. The difference between biological healing times and patient-reported outcomes, on one hand, and clinical measures of hip function, on the other, may explain why surgeons reported more optimistic expectations regarding RTS times than physiotherapists did. The largest improvements in self-reported hip pain and ADL function occur early (within three months) following surgery (36, 86). Combining these results with expected tissue healing times, it is understandable that surgeons recommended RTS times of 12–20 weeks in 2015 (87). However, in comparison with pain reduction and improved ADL function, self-reported sporting function appears to improve later in the process (>6 months post-op) (36, 86). Clinical measures of hip function such as muscle strength and ROM may recover more slowly and still be impaired compared with healthy hips long after surgery (88). Physiotherapists' more pessimistic expectations regarding RTS times may therefore be influenced by their focus on slower recovering clinical measures of hip function. However, neither the surgeons nor physiotherapists examined in study 1 had realistic expectations regarding the time patients need to return to competitive sports, as we saw in study 2.

Return to sport: Results depend on the definition

Surgeons expected a median time of 12 weeks for patients to return to competitive sport and physiotherapists expected a median time of 18 weeks. In study 2, patients reported a mean RTS time of 32 weeks, which is much longer than the clinicians' expectations reported in study 1 but in accordance with other studies on RTS following hip arthroscopy (74, 89). We assessed RTS by reporting it on a continuum, an approach recommended by expert consensus (76) and used in other orthopedic populations, such as patients following ACL reconstruction (90).

At the time of publication, our study was the first to report RTS following hip arthroscopy in this manner and its results provided a new perspective on the available statistics. According to systematic reviews, 90% of all patients undergoing hip arthroscopy are reported to RTS following hip arthroscopy (72, 89). When we defined RTS as return to any kind of sport, we also found that nine out of ten patients returned to sport. By applying a more nuanced definition and looking at the kinds of sports the patients return to, we gain a more sober perspective. We saw that 49% of all patients returned to their previous sports but that only one in five patients returned to their previous level of sports performance. In their systematic review, Reiman et al. (89) reported that 74% of all patients returned to the same performance level of the sport they participated in before their surgery. Their pooled RTS rate was based on studies including professional athletes (seven out of 13 included studies) and high school or collegiate athletes (five out of 13 included studies). Only one out of 13 studies included in the systematic review (89) included recreational athletes. In our study, we included a wide range of activity levels, and it is likely that professional athletes RTS at higher rates (91). Shortly after we published our results, a study based on the Danish hip arthroscopy register reported that 57% of all patients return to their previous sports, but only 17% reported optimal performance (92). The strikingly similar rates observed in our sample and in the study from Denmark (92) show that clear definitions of RTS are needed to obtain a nuanced picture of RTS rates following hip arthroscopy. Such a nuanced picture is needed to inform patients and create realistic expectations regarding RTS following hip arthroscopy. Future studies, prospectively describing RTS and including return to performance are needed to better understand the process awaiting our patients following hip arthroscopy. Since RTS is such an important outcome for our patients, being closely related to their satisfaction with treatment (61, 79), we proceeded to investigate potential explanations for the low rate of patients returning to previous performance levels following hip arthroscopy.

How can we explain the observed return to sport rates?

We schedule athletic patients with FAI syndrome and a desire to RTS for surgery. We remove the mechanical constraint hypothesized to cause their symptoms and provide structured rehabilitation with the end goal of RTS. Yet, half of these patients will not return to their previous sports (61, 79, 92) and most will still have considerable impairments in self-reported function long after surgery (36, 37). In studies 3 and 4 of this thesis, we examined potential reasons for these findings.

Why don't we see what patients tell us?

In study 3, we examined self-reported as well as clinically assessed hip function in patients following hip arthroscopy during a time when they can expect to RTS (6–10 months post-surgery). We then compared them with a healthy control group and the operated hip with the non-operated hip.

Unlike healthy individuals, patients reported significantly impaired hip function. Since we used HAGOS as the patient-reported outcome measure, we can see an interesting pattern of impairments on the different subscales. Patients achieved relatively high function on the Pain and ADL subscales, while greater impairments are seen on the Sport and Physical Activity subscales. This pattern, indicating larger restrictions in domains related to participation, as defined by the ICF (62), is typical of patients with FAI syndrome before and after arthroscopy (93-95). A recent study reported that 60% of hip arthroscopy patients fail to reach a patient-acceptable symptom state (PASS) on the HAGOS Sport subscale (93). In the same study, the odds of achieving an overall PASS were higher for patients achieving PASS in relation to sport than for those achieving this benchmark in relation to ADL function (93). Hence, overall results indicate that we are better at improving patients' ADL function than sporting function, but that the sporting function appears to be very important to patients. In the clinic, we measure sporting function indirectly by assessing factors such as ROM and strength, which are needed to participate in sport, and more directly by measuring performance-based measures. Considering the marked impairments our patients report, it is reasonable to expect that we should be able to observe relevant impairments in clinically measured function.

In our cross-sectional study (80), we found a general pattern of impaired clinically measured hip function in hip arthroscopy patients compared with healthy controls. However, the effect sizes for the majority of the included outcomes were small and mostly statistically non-significant. Only differences in measures related to hip mobility were statistically significant and with effect sizes that were arguably clinically relevant. These measures included hip ROM, hip flexion strength, and the YBT in the posteromedial direction. Hence, the largest differences were observed in aspects of function in the direction of impingement, indicating that patients' hip

joints still had diagnosis-specific impairments. FAI syndrome is defined as a motion-related disorder with limited hip flexion and rotation ROM (1), and the correction of hip morphology is thought to eliminate anatomical constraints and thereby improve ROM (34). However, the typical cartilage injuries associated with cam and pincer morphology remain (27, 28, 31, 32). These cartilage injuries, which may be early manifestations of hip osteoarthritis (38), could explain the impaired hip mobility in hip arthroscopy patients. Impaired hip mobility is also a clinical finding in patients with hip osteoarthritis (96, 97) and is associated with reduced self-reported quality of life following hip arthroscopy (98). Nevertheless, the effect sizes in our study were generally small and the impairments related to chondropathy were arguably large enough for patients to self-report them but not large enough to be clinically measured. To date, we still have little information about the extent to which hip ROM changes following hip arthroscopy. The only RCT reporting hip ROM found an improvement in hip flexion following hip arthroscopy (35). According to another prospective study, hip flexion and rotation ROM improves during the first six months following surgery but remains lower than in healthy control subjects (88). It is surprising that hip ROM, which is related to cam morphology (99), has not been described more frequently in studies evaluating outcomes following hip arthroscopy. We observed smaller impairments in hip muscle strength and performance-based measures than found in other cross-sectional studies (100-102). Differences in study samples could potentially explain these differences. While we only included patients operated on for FAI syndrome, these other studies (100-102) included patients operated on for hip pain, and only half of them could be considered FAI syndrome patients. Hip muscle strength is reported to improve following hip arthroscopy and post-operative rehabilitation but to remain impaired in comparison with healthy individuals (88, 103). We did not find a consistent pattern of impairments when comparing the surgically treated hip with the healthy hip on our patients. Side-to-side comparison of hip function in patients with FAI syndrome is arguably of limited value due to the high prevalence of morphological variations on both sides (104). Even though reported side-to-side differences in hip muscle strength are also associated with relatively small effect sizes in other studies, hip flexion and extension strength are associated with self-reported sporting function (105, 106). Hip ROM and strength can be affected by active rehabilitation, and future research is needed to further understand their impact on patients' function and to optimize rehabilitation strategies. Nevertheless, the impairments observed during clinical assessments alone do not explain the marked reductions in self-reported function and low RTS rates following hip arthroscopy. In the last study of this thesis, we therefore looked beyond the physical aspects of hip function.

Psychological readiness to return to sport: A piece of the puzzle?

Psychological factors have long been linked to RTS following athletic injury (77) and should therefore be assessed in the RTS process (76). In particular, psychological readiness, a construct including emotions, confidence in performance, and risk appraisal (107), has been shown to be a strong predictor of return to pre-injury sport participation and performance (108). Work on ACL-reconstructed patients has pioneered this line of research, and the ACL Return to Spot after Injury (ACL-RSI) scale has become an established tool with which to measure psychological readiness to RTS in these patients (107-109). However, psychological readiness had not yet been investigated in hip arthroscopy patients at the time our project was initiated.

In the last study of this thesis, we modified and presented the psychometric properties of the Hip-RSI (81), a hip-adapted version of the Swedish ACL-RSI (109). In contrast to another 2020 study, presenting the psychometric properties of a short ACL-RSI version for use in hip arthroscopy patients (110), we used hip arthroscopy patients to reduce the items of the original 12-item scale to our short six-item version. The involvement of patients in the item reduction process resulted in a short version of the Hip-RSI with more focus on confidence in performance than on joint stability and fear of re-injury, which appear more relevant to ACL-reconstructed patients. These fundamental differences in psychological response to the RTS process highlight what matters to hip arthroscopy patients, but also what may affect their ability to RTS. While RTS in ACL-reconstructed patients may be hindered by fear of re-injury and recurrent instability (111), hip arthroscopy patients appear to be most affected by the threat of pain during and after sport participation (92). Our item reduction likely eliminated the questions of little relevance to hip arthroscopy patients but may have missed relevant questions, for example, concerning fear of pain, since the original scale was based on ACL patients. Nevertheless, our effort to validate the short Hip-RSI indicates that it is an appropriate measure to capture psychological readiness in hip arthroscopy patients and that it can differentiate between those returning to various levels of RTS.

With the Hip-RSI, clinicians treating hip arthroscopy patients now have the ability to measure psychological readiness in the RTS process. We need to complete the assessment of the remaining psychometric properties of the scale, such as test-retest reliability and responsiveness (112). Future research also needs to shed light on the trajectory of psychological readiness throughout the rehabilitation process, with or without arthroscopic treatment. As we can see in ACL-reconstructed patients, psychological recovery from surgery appears to be distinct from physical recovery (113). However, further research is warranted to measure psychological recovery alongside physical recovery in hip arthroscopy patients to examine to what extent these processes relate to each other.

Clinical implications

The individual studies also describe my journey as a clinician over the years, working with hip arthroscopy patients on a daily basis. Being born out of clinical questions that developed during my daily work with FAI syndrome patients, the studies included in this thesis all have clinical relevance. Our special-care survey of current rehabilitation practices following hip arthroscopy in Scandinavia highlighted important similarities and differences between professions as well as shared clinical uncertainties. Care of patients with FAI syndrome is multidisciplinary, and it is important that the involved professions provide patients with shared expectations. Different expectations regarding the rehabilitation timeline could cause confusion among patients, who may receive mixed messages from clinicians. Study 2 revealed that all clinicians had overly optimistic expectations regarding RTS times following hip arthroscopy, and that RTS rates appear not to be as high as previously reported. Together, these two studies have helped me to provide more nuanced information to my patients in order to create realistic expectations. Realistic expectations are associated with more treatment satisfaction and should be aimed for in clinical care. As clinicians, we put great value in clinically measured outcomes such as ROM and muscle strength. Study 3 showed that these clinical measures may indicate reduced functions in larger groups of hip arthroscopy patients, but the size of the effects call into question to what extent these subtle differences can be interpreted in an RTS context. Simultaneously, self-reported outcome measures, with their ability to capture functional impairments in different domains, could be used more frequently by physiotherapists. Finally, we have highlighted that there may be other factors than physical function involved in the RTS process. Clinicians should be aware of psychological readiness to RTS and its relationship with RTS on different levels. More importantly, now clinicians have a tool with which to assess psychological readiness to RTS in their hip arthroscopy patients.

Methodological considerations

In study 1, we asked participating surgeons and physiotherapists to answer all questions with a typical hip arthroscopy patient in mind. We provided them with the following definition: “The patient is 25–40 years old with femoroacetabular impingement syndrome and chondrolabral injury.” This very rough definition describes the target population of this thesis. Our aim was to generalize results to the typical hip arthroscopy patient entering Swedish clinics. The samples in the included studies consisted mainly of male patients with cam morphology. Hence, our results cannot be generalized to patients with pincer morphology and should be cautiously generalized to female patients. However, it appears that the typical hip

arthroscopy patient in Sweden is male and has received a surgical removal of cam morphology (44), which strengthens the generalizability of our results. There are other possible sources of selection bias potentially affecting the generalizability. All patients included in the studies were operated on at the same clinic, mostly by a single surgeon, so the outcomes may not be completely representative of HA patients operated on in all clinics, nationally or internationally. Nevertheless, Sweden is a small country and national consensus meetings have been organized to unify practice, so I do not expect clinical practice to differ substantially between clinics.

We collected data via surveys in all studies. All but one of these surveys included valid and reliable patient-reported outcomes, but we also constructed aspects of these surveys ourselves. Therefore, not all aspects of our surveys have been validated. At the same time, it is not possible to use validated tools for the exploration of novel questions. Nevertheless, we took great effort to ensure the quality of these self-constructed survey elements. After reaching consensus about survey contents and item formulation among ourselves, we included other experts, such as surgeons, physiotherapists, and patients, to ensure that we were measuring what we intended to measure in a comprehensive fashion. We also used officially licensed translators for surveys that had to be delivered in different languages.

Due to the cross-sectional design of studies 2 and 3, we could not conclude that the observed RTS rates or patients' hip function were the end results of treatment. In both studies, patients responded to our questions while they may or may not have reached the end of rehabilitation. However, we examined differences in RTS rates in groups of patients at different time points and found no big differences in rates after six months following surgery. Even though other cross-sectional studies have reported similar RTS rates (92, 114), prospective studies are needed to confirm these findings. Patients may recover from surgical trauma and improve hip function beyond the 6–10-month period included in study 3. Future investigations may shed light on the long-term development of clinical hip function over time and describe the RTS journey prospectively and in more detail.

Finally, we adapted an instrument originally for ACL patients (ACL-RSI) (109) for use with hip patients (Hip-RSI). Item reduction based on patient responses and expert rating likely eliminated questions of little relevance to hip patients, but it is possible that the final Hip-RSI might be missing aspects important to this patient population. Furthermore, we did not assess the test-retest reliability and responsiveness of the Hip-RSI, which the COSMIN guidelines recommend describing (112). Future studies are needed to identify missing questions on the Hip-RSI, describe the remaining psychometric properties of the scale, and examine patient responses throughout the rehabilitation period.

Conclusions

In Scandinavia, rehabilitation following hip arthroscopy for FAI syndrome is physiotherapist-led, structured rehabilitation mainly based on exercise therapy. Clinicians share similar expectations regarding the timeline required to return patients to ADL function. As patients get closer to RTS, expectations of clinicians display increasing variation. While nine out of ten patients return to some kind of sport participation following hip arthroscopy, only half of them return to their previous sport and only one in five returns to the previous sport performance level. At the time when RTS is expected, only subtle impairments related to hip mobility are detected during clinical assessments, while patients self-report vast impairments in sporting function. Patients who have reached higher levels of RTS also have higher levels of psychological readiness for RTS. Psychological readiness may therefore play an important part in the RTS process and could be assessed with the Hip-RSI. Future research is warranted to prospectively describe RTS following hip arthroscopy, explore potential factors associated with successful RTS, and test as well as implement optimized rehabilitation strategies for these patients.

Acknowledgements

Research is a team sport, and I would like to extend my deepest gratitude to everyone on my team, both on and off the pitch. Without you, my PhD would not have been possible. Especially, I would like to thank the following:

Frida Eek, my main supervisor, mentor, and the reason I am writing this thesis. We met as student and teacher, and I can remember being amazed by the passion you had for teaching research methodology and statistics. Thank you for opening the doors so I could continue my education after my MSc. You made sure that my forskarutbildning (Swedish for "research education") really was what the word suggests, by always putting my learning experience first. Thank you for all your time, for sharing all your knowledge, and for passing on your love for science. I hope you will keep your passion for learning and that you will continue inspiring others as you inspire me. I am forever grateful to have had you as a mentor and friend and hope to continue our work for many years to come.

Kristian Thorborg, my co-supervisor, hip and groin expert clinician, and researcher. All football fans recognize "Danish dynamite," and I recognize Danish dynamite from our work together. Opening an email with feedback from you was sometimes like stepping on a landmine. Thank you for always saying the uncomfortable but necessary. Sometimes it felt as if I had more questions after your feedback than before, but learning does not mean being given all the answers. Thank you for welcoming, introducing, and including me in the hip and groin research community. Thank you for giving me an incredible platform as a young researcher. The field has made enormous progress since we started our journey, and I hope we will continue this development together.

Anders Stålman, co-author and colleague at Capio Artro Clinic, my link between the clinic and research. Together we have treated patients and produced research. Thank you for sharing your expertise, for helping me better understand the surgical perspective, and for always making time in your busy schedule to share your academic and clinical expertise.

Håvard Moksnes and Kate Webster, co-authors. Planning, performing, and reporting study results with experienced researchers like you has been an enormous learning experience for me. Thank you for your contributions.

Viktor Granlund, Johanna Nilsson, and Hanna Momats Olsson, co-authors and colleagues. Thank you for going on this journey with me and planning and performing a study together, and especially for standing in the gym with me during holidays and weekends to measure participants.

Christina Mikkelsen, the world's best boss. "Boss" doesn't do you justice, as you have meant so much to my professional development. Thank you for trusting me and supporting my dreams. Thank you for hiring a German physiotherapist with a Dutch degree who barely spoke Swedish. Thank you for encouraging me to train to become a researcher and for making it possible to combine that goal with my clinical work. Thank you for introducing me to the Swedish sports medicine community and for making me feel instantly welcome. You are the glue holding our team together and one of the main reasons why I think I have the best job in the country. Thank you.

All my colleagues at Capio Artro Clinic. Sitting with my computer in the middle of a buzzing clinic sometimes makes me feel like an island. Thank you, guys, for building bridges! Being able to reconnect research to the clinic is a massive asset. I can't count the times I was sitting there with one of you, discussing something I had read, written, or found. Those discussions enriched my perspective every single time. Sorry for the times I may have been stressed, unapproachable, or in my own world. Thank you for the needed coffee breaks, for distracting discussions about football, food, and life, and for making me want to go back to work by talking about golf. You all are awesome!

Pontus Andersson, Pontus Art Production, thank you for the beautiful anatomical pictures.

Mamma und Pappa, thank you for always being there for me. In the 1990s, you never would have thought that you would read these lines at the end of a doctoral thesis. Well, here we are and here I am, largely because of you! Thank you for always believing in me and for your unconditional love.

Mehranoush and Nasser, my parents in law. Thank you for all your help over the years. It is not easy to raise a family with small kids while completing a PhD; it is impossible to do it without support. You have been a great support to me and Nilo. Thank you for seeing my achievements as our achievements and being there for me.

Nilo, my lovely wife. Thank you for loving and supporting me throughout these busy years. I know it was not easy to juggle work and family while adjusting to my schedule. Thank you for being you! Now it's your turn—I love you.

Tiam and Nia, my wonderful kids. Thank you for reminding me about what matters most in life—every day when I left, every day when I came home, every time I only saw your faces through a screen. You are my everything!

References

1. Griffin DR, Dickenson EJ, O'Donnell J, Agricola R, Awan T, Beck M, et al. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement. British journal of sports medicine. 2016;50(19):1169-76.
2. Harris WH. Etiology of osteoarthritis of the hip. Clin Orthop Relat Res. 1986(213):20-33.
3. Smith-Petersen MN. The classic: Treatment of malum coxae senilis, old slipped upper femoral epiphysis, intrapelvic protrusion of the acetabulum, and coxa plana by means of acetabuloplasty. 1936. Clin Orthop Relat Res. 2009;467(3):608-15.
4. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. Clin Orthop Relat Res. 2003(417):112-20.
5. Frank JM, Harris JD, Erickson BJ, Slikker W, 3rd, Bush-Joseph CA, Salata MJ, et al. Prevalence of Femoroacetabular Impingement Imaging Findings in Asymptomatic Volunteers: A Systematic Review. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2015;31(6):1199-204.
6. Agricola R, Bessems JH, Ginai AZ, Heijboer MP, van der Heijden RA, Verhaar JA, et al. The development of Cam-type deformity in adolescent and young male soccer players. The American journal of sports medicine. 2012;40(5):1099-106.
7. Palmer A, Fernquest S, Gimpel M, Birchall R, Judge A, Broomfield J, et al. Physical activity during adolescence and the development of cam morphology: a cross-sectional cohort study of 210 individuals. British journal of sports medicine. 2018;52(9):601-10.
8. Siebenrock KA, Ferner F, Noble PC, Santore RF, Werlen S, Mamisch TC. The cam-type deformity of the proximal femur arises in childhood in response to vigorous sporting activity. Clin Orthop Relat Res. 2011;469(11):3229-40.
9. Agricola R, Heijboer MP, Ginai AZ, Roels P, Zadpoor AA, Verhaar JA, et al. A cam deformity is gradually acquired during skeletal maturation in adolescent and young male soccer players: a prospective study with minimum 2-year follow-up. The American journal of sports medicine. 2014;42(4):798-806.
10. van Klij P, Heijboer MP, Ginai AZ, Verhaar JAN, Waarsing JH, Agricola R. Cam morphology in young male football players mostly develops before proximal femoral growth plate closure: a prospective study with 5-yearfollow-up. British journal of sports medicine. 2019;53(9):532-8.

11. Hogervorst T, Bouma HW, de Vos J. Evolution of the hip and pelvis. Acta Orthop Suppl. 2009;80(336):1-39.
12. Carton PF, Filan DJ. The clinical presentation, diagnosis and pathogenesis of symptomatic sports-related femoroacetabular impingement (SRFAI) in a consecutive series of 1021 athletic hips. Hip international : the journal of clinical and experimental research on hip pathology and therapy. 2019;29(6):665-73.
13. Clohisy JC, Knaus ER, Hunt DM, Lesher JM, Harris-Hayes M, Prather H. Clinical presentation of patients with symptomatic anterior hip impingement. Clin Orthop Relat Res. 2009;467(3):638-44.
14. Sansone M, Ahlden M, Jonasson P, Thomee C, Sward L, Baranto A, et al. Good Results After Hip Arthroscopy for Femoroacetabular Impingement in Top-Level Athletes. Orthop J Sports Med. 2015;3(2):2325967115569691.
15. Philippon MJ, Maxwell RB, Johnston TL, Schenker M, Briggs KK. Clinical presentation of femoroacetabular impingement. Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 2007;15(8):1041-7.
16. Tijssen M, van Cingel RE, de Visser E, Holmich P, Nijhuis-van der Sanden MW. Hip joint pathology: relationship between patient history, physical tests, and arthroscopy findings in clinical practice. Scandinavian journal of medicine & science in sports. 2017;27(3):342-50.
17. Freke MD, Kemp J, Svege I, Risberg MA, Semciw A, Crossley KM. Physical impairments in symptomatic femoroacetabular impingement: a systematic review of the evidence. British journal of sports medicine. 2016;50(19):1180.
18. Reiman MP, Thorborg K. Clinical examination and physical assessment of hip joint-related pain in athletes. International journal of sports physical therapy. 2014;9(6):737-55.
19. Reiman MP, Goode AP, Cook CE, Holmich P, Thorborg K. Diagnostic accuracy of clinical tests for the diagnosis of hip femoroacetabular impingement/labral tear: a systematic review with meta-analysis. British journal of sports medicine. 2015;49(12):811.
20. Notzli HP, Wyss TF, Stoecklin CH, Schmid MR, Treiber K, Hodler J. The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement. The Journal of bone and joint surgery British volume. 2002;84(4):556-60.
21. Agricola R, Waarsing JH, Thomas GE, Carr AJ, Reijman M, Bierma-Zeinstra SM, et al. Cam impingement: defining the presence of a cam deformity by the alpha angle: data from the CHECK cohort and Chingford cohort. Osteoarthritis and cartilage / OARS, Osteoarthritis Research Society. 2014;22(2):218-25.
22. Gosvig KK, Jacobsen S, Palm H, Sonne-Holm S, Magnusson E. A new radiological index for assessing asphericity of the femoral head in cam impingement. The Journal of bone and joint surgery British volume. 2007;89(10):1309-16.
23. Agricola R, Heijboer MP, Roze RH, Reijman M, Bierma-Zeinstra SM, Verhaar JA, et al. Pincer deformity does not lead to osteoarthritis of the hip whereas acetabular dysplasia does: acetabular coverage and development of osteoarthritis in a nationwide prospective cohort study (CHECK). Osteoarthritis and cartilage / OARS, Osteoarthritis Research Society. 2013;21(10):1514-21.

24. Mosler AB, Crossley KM, Waarsing JH, Jomaah N, Weir A, Holmich P, et al. Ethnic Differences in Bony Hip Morphology in a Cohort of 445 Professional Male Soccer Players. The American journal of sports medicine. 2016;44(11):2967-74.
25. Nawabi DH, Bedi A, Tibor LM, Magennis E, Kelly BT. The demographic characteristics of high-level and recreational athletes undergoing hip arthroscopy for femoroacetabular impingement: a sports-specific analysis. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2014;30(3):398-405.
26. Lavigne M, Parvizi J, Beck M, Siebenrock KA, Ganz R, Leunig M. Anterior femoroacetabular impingement: part I. Techniques of joint preserving surgery. Clin Orthop Relat Res. 2004(418):61-6.
27. Ishoi L, Thorborg K, Kraemer O, Lund B, Mygind-Klavsen B, Holmich P. Demographic and Radiographic Factors Associated With Intra-articular Hip Cartilage Injury: A Cross-sectional Study of 1511 Hip Arthroscopy Procedures. The American journal of sports medicine. 2019;47(11):2617-25.
28. Lund B, Nielsen TG, Lind M. Cartilage status in FAI patients - results from the Danish Hip Arthroscopy Registry (DHAR). SICOT J. 2017;3:44.
29. Sogbein OA, Shah A, Kay J, Memon M, Simunovic N, Belzile EL, et al. Predictors of Outcomes After Hip Arthroscopic Surgery for Femoroacetabular Impingement: A Systematic Review. Orthop J Sports Med. 2019;7(6):2325967119848982.
30. van Klij P, Heerey J, Waarsing JH, Agricola R. The Prevalence of Cam and Pincer Morphology and Its Association With Development of Hip Osteoarthritis. The Journal of orthopaedic and sports physical therapy. 2018;48(4):230-8.
31. Beck M, Kalhor M, Leunig M, Ganz R. Hip morphology influences the pattern of damage to the acetabular cartilage: femoroacetabular impingement as a cause of early osteoarthritis of the hip. The Journal of bone and joint surgery British volume. 2005;87(7):1012-8.
32. Suarez-Ahedo C, Gui C, Rabe SM, Chandrasekaran S, Lodhia P, Domb BG. Acetabular Chondral Lesions in Hip Arthroscopy: Relationships Between Grade, Topography, and Demographics. The American journal of sports medicine. 2017;45(11):2501-6.
33. Ferreira GE, O'Keeffe M, Maher CG, Harris IA, Kwok WS, Peek AL, et al. The effectiveness of hip arthroscopic surgery for the treatment of femoroacetabular impingement syndrome: A systematic review and meta-analysis. Journal of science and medicine in sport / Sports Medicine Australia. 2021;24(1):21-9.
34. Griffin DR, Dickenson EJ, Wall PDH, Achana F, Donovan JL, Griffin J, et al. Hip arthroscopy versus best conservative care for the treatment of femoroacetabular impingement syndrome (UK FASHIoN): a multicentre randomised controlled trial. Lancet. 2018;391(10136):2225-35.
35. Palmer AJR, Ayyar Gupta V, Fernquest S, Rombach I, Dutton SJ, Mansour R, et al. Arthroscopic hip surgery compared with physiotherapy and activity modification for the treatment of symptomatic femoroacetabular impingement: multicentre randomised controlled trial. Bmj. 2019;364:l185.

36. Kierkegaard S, Langeskov-Christensen M, Lund B, Naal FD, Mechlenburg I, Dalgas U, et al. Pain, activities of daily living and sport function at different time points after hip arthroscopy in patients with femoroacetabular impingement: a systematic review with meta-analysis. British journal of sports medicine. 2016.
37. Thorborg K, Kraemer O, Madsen AD, Holmich P. Patient-Reported Outcomes Within the First Year After Hip Arthroscopy and Rehabilitation for Femoroacetabular Impingement and/or Labral Injury: The Difference Between Getting Better and Getting Back to Normal. The American journal of sports medicine. 2018:363546518786971.
38. Teichtahl AJ, Wang Y, Smith S, Wluka AE, Giles GG, Bennell KL, et al. Structural changes of hip osteoarthritis using magnetic resonance imaging. Arthritis Res Ther. 2014;16(5):466.
39. Bozic KJ, Chan V, Valone FH, 3rd, Feeley BT, Vail TP. Trends in hip arthroscopy utilization in the United States. J Arthroplasty. 2013;28(8 Suppl):140-3.
40. Haviv B, Burg A, Velkes S, Salai M, Dudkiewicz I. Trends in femoroacetabular impingement research over 11 years. Orthopedics. 2011;34(5):353. doi: 10.3928/01477447-20110317-04.
41. Maradit Kremers H, Schilz SR, Van Houten HK, Herrin J, Koenig KM, Bozic KJ, et al. Trends in Utilization and Outcomes of Hip Arthroscopy in the United States Between 2005 and 2013. J Arthroplasty. 2017;32(3):750-5.
42. Montgomery SR, Ngo SS, Hobson T, Nguyen S, Alluri R, Wang JC, et al. Trends and demographics in hip arthroscopy in the United States. Arthroscopy. 2013;29(4):661-5. doi: 10.1016/j.arthro.2012.11.005. Epub 3 Feb 1.
43. Palmer AJ, Malak TT, Broomfield J, Holton J, Majkowski L, Thomas GE, et al. Past and projected temporal trends in arthroscopic hip surgery in England between 2002 and 2013. BMJ Open Sport Exerc Med. 2016;2(1):e000082.
44. Worner T, Eek F, Kraus-Schmitz J, Sansone M, Stalman A. Rapid decline of yearly number of hip arthroscopies in Sweden: a retrospective time series of 6,105 hip arthroscopies based on a national patient data register. Acta Orthop. 2021:1-6.
45. Reiman MP, Thorborg K. Femoroacetabular impingement surgery: are we moving too fast and too far beyond the evidence? British journal of sports medicine. 2015.
46. Mansell NS, Rhon DI, Marchant BG, Slevin JM, Meyer JL. Two-year outcomes after arthroscopic surgery compared to physical therapy for femoracetabular impingement: A protocol for a randomized clinical trial. BMC musculoskeletal disorders. 2016;17:60.
47. Risberg MA, Ageberg E, Nilstad A, Lund B, Nordsletten L, Loken S, et al. Arthroscopic Surgical Procedures Versus Sham Surgery for Patients With Femoroacetabular Impingement and/or Labral Tears: Study Protocol for a Randomized Controlled Trial (HIPARTI) and a Prospective Cohort Study (HARP). The Journal of orthopaedic and sports physical therapy. 2018;48(4):325-35.
48. Kemp JL, King MG, Barton C, Schache AG, Thorborg K, Roos EM, et al. Is exercise therapy for femoroacetabular impingement in or out of FASHIoN? We need to talk about current best practice for the non-surgical management of FAI syndrome. British journal of sports medicine. 2019;53(19):1204-5.

49. Cheatham SW, Enseki KR, Kolber MJ. Post-Operative Rehabilitation after Hip Arthroscopy: A Search for the Evidence. J Sport Rehabil. 2014:12.
50. Grzybowski JS, Malloy P, Stegemann C, Bush-Joseph C, Harris JD, Nho SJ. Rehabilitation Following Hip Arthroscopy - A Systematic Review. Frontiers in surgery. 2015;2:21.
51. Amar E, Sharfman ZT, Rath E. Heterotopic ossification after hip arthroscopy. J Hip Preserv Surg. 2015;2(4):355-63.
52. Willimon SC, Briggs KK, Philippon MJ. Intra-articular adhesions following hip arthroscopy: a risk factor analysis. Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 2014;22(4):822-5.
53. Edelstein J, Ranawat A, Enseki KR, Yun RJ, Draovitch P. Post-operative guidelines following hip arthroscopy. Current reviews in musculoskeletal medicine. 2012;5(1):15-23.
54. Garrison JC, Osler MT, Singleton SB. Rehabilitation after arthroscopy of an acetabular labral tear. North American journal of sports physical therapy : NAJSPT. 2007;2(4):241-50.
55. Voight ML, Robinson K, Gill L, Griffin K. Postoperative rehabilitation guidelines for hip arthroscopy in an active population. Sports health. 2010;2(3):222-30.
56. Wahoff M, Ryan M. Rehabilitation after hip femoroacetabular impingement arthroscopy. Clinics in sports medicine. 2011;30(2):463-82.
57. Wall PD, Fernandez M, Griffin DR, Foster NE. Nonoperative treatment for femoroacetabular impingement: a systematic review of the literature. PM & R : the journal of injury, function, and rehabilitation. 2013;5(5):418-26.
58. Kemp JL, Risberg MA, Mosler A, Harris-Hayes M, Serner A, Moksnes H, et al. Physiotherapist-led treatment for young to middle-aged active adults with hip-related pain: consensus recommendations from the International Hip-related Pain Research Network, Zurich 2018. British journal of sports medicine. 2020;54(9):504-11.
59. Impellizzeri FM, Jones DM, Griffin D, Harris-Hayes M, Thorborg K, Crossley KM, et al. Patient-reported outcome measures for hip-related pain: a review of the available evidence and a consensus statement from the International Hip-related Pain Research Network, Zurich 2018. British journal of sports medicine. 2020;54(14):848-57.
60. Mosler AB, Kemp J, King M, Lawrenson PR, Semciw A, Freke M, et al. Standardised measurement of physical capacity in young and middle-aged active adults with hip-related pain: recommendations from the first International Hip-related Pain Research Network (IHiPRN) meeting, Zurich, 2018. British journal of sports medicine. 2020;54(12):702-10.
61. Mannion AF, Impellizzeri FM, Naal FD, Leunig M. Fulfilment of patient-rated expectations predicts the outcome of surgery for femoroacetabular impingement. Osteoarthritis and cartilage / OARS, Osteoarthritis Research Society. 2013;21(1):44-50.
62. Kostanjsek N. Use of The International Classification of Functioning, Disability and Health (ICF) as a conceptual framework and common language for disability statistics and health information systems. BMC Public Health. 2011;11 Suppl 4:S3.

63. Thorborg K, Tijssen M, Habets B, Bartels EM, Roos EM, Kemp J, et al. Patient-Reported Outcome (PRO) questionnaires for young to middle-aged adults with hip and groin disability: a systematic review of the clinimetric evidence. British journal of sports medicine. 2015.
64. Thorborg K, Holmich P, Christensen R, Petersen J, Roos EM. The Copenhagen Hip and Groin Outcome Score (HAGOS): development and validation according to the COSMIN checklist. British journal of sports medicine. 2011;45(6):478-91.
65. Griffin DR, Parsons N, Mohtadi NG, Safran MR, Multicenter Arthroscopy of the Hip Outcomes Research N. A short version of the International Hip Outcome Tool (iHOT-12) for use in routine clinical practice. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2012;28(5):611-6; quiz 6-8.
66. Mohtadi NG, Griffin DR, Pedersen ME, Chan D, Safran MR, Parsons N, et al. The Development and validation of a self-administered quality-of-life outcome measure for young, active patients with symptomatic hip disease: the International Hip Outcome Tool (iHOT-33). Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2012;28(5):595-605; quiz 6-10 e1.
67. Naal FD, Miozzari HH, Kelly BT, Magennis EM, Leunig M, Noetzli HP. The Hip Sports Activity Scale (HSAS) for patients with femoroacetabular impingement. Hip international : the journal of clinical and experimental research on hip pathology and therapy. 2013;23(2):204-11.
68. Nussbaumer S, Leunig M, Glatthorn JF, Stauffacher S, Gerber H, Maffiuletti NA. Validity and test-retest reliability of manual goniometers for measuring passive hip range of motion in femoroacetabular impingement patients. BMC musculoskeletal disorders. 2010;11:194.
69. Diamond LE, Dobson FL, Bennell KL, Wrigley TV, Hodges PW, Hinman RS. Physical impairments and activity limitations in people with femoroacetabular impingement: a systematic review. British journal of sports medicine. 2015;49(4):230-42.
70. Thorborg K, Petersen J, Magnusson SP, Holmich P. Clinical assessment of hip strength using a hand-held dynamometer is reliable. Scandinavian journal of medicine & science in sports. 2010;20(3):493-501.
71. Kivlan BR, Martin RL. Functional performance testing of the hip in athletes: a systematic review for reliability and validity. International journal of sports physical therapy. 2012;7(4):402-12.
72. Casartelli NC, Leunig M, Maffiuletti NA, Bizzini M. Return to sport after hip surgery for femoroacetabular impingement: a systematic review. British journal of sports medicine. 2015;49(12):819-24.
73. Hegedus EJ, McDonough SM, Bleakley C, Baxter D, Cook CE. Clinician-friendly lower extremity physical performance tests in athletes: a systematic review of measurement properties and correlation with injury. Part 2--the tests for the hip, thigh, foot and ankle including the star excursion balance test. British journal of sports medicine. 2015;49(10):649-56.

74. O'Connor M, Minkara AA, Westermann RW, Rosneck J, Lynch TS. Return to Play After Hip Arthroscopy: A Systematic Review and Meta-analysis. The American journal of sports medicine. 2018:363546518759731.
75. Bedi A, Kelly BT. Femoroacetabular impingement. The Journal of bone and joint surgery American volume. 2013;95(1):82-92.
76. Ardern CL, Glasgow P, Schneiders A, Witvrouw E, Clarsen B, Cools A, et al. 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. British journal of sports medicine. 2016;50(14):853-64.
77. Ardern CL, Taylor NF, Feller JA, Webster KE. A systematic review of the psychological factors associated with returning to sport following injury. British journal of sports medicine. 2013;47(17):1120-6.
78. Worner T, Thorborg K, Moksnes H, Eek F. Similar views on rehabilitation following hip arthroscopy among physiotherapists and surgeons in Scandinavia: a specialized care survey. Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 2018;26(8):2519-26.
79. Worner T, Thorborg K, Stalman A, Webster KE, Momatz Olsson H, Eek F. High or low return to sport rates following hip arthroscopy is a matter of definition? British journal of sports medicine. 2018;52(22):1475-6.
80. Worner T, Nilsson J, Thorborg K, Granlund V, Stalman A, Eek F. Hip Function 6 to 10 Months After Arthroscopic Surgery: A Cross-sectional Comparison of Subjective and Objective Hip Function, Including Performance-Based Measures, in Patients Versus Controls. Orthop J Sports Med. 2019;7(6):2325967119844821.
81. Worner T, Thorborg K, Webster KE, Stalman A, Eek F. Psychological readiness is related to return to sport following hip arthroscopy and can be assessed by the Hip-Return to Sport after Injury scale (Hip-RSI). Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 2020.
82. Enseki KR, Martin RL, Draovitch P, Kelly BT, Philippon MJ, Schenker ML. The hip joint: arthroscopic procedures and postoperative rehabilitation. The Journal of orthopaedic and sports physical therapy. 2006;36(7):516-25.
83. Stalzer S, Wahoff M, Scanlan M. Rehabilitation following hip arthroscopy. Clinics in sports medicine. 2006;25(2):337-57, x.
84. Ankem HK, Yelton MJ, Lall AC, Bendersky AM, Rosinsky PJ, Maldonado DR, et al. Structured physical therapy protocols following hip arthroscopy and their effect on patient-reported outcomes-a systematic review of the literature. J Hip Preserv Surg. 2020;7(3):357-77.
85. Bistolfi A, Guidotti C, Aprato A, Sabatini L, Artiaco S, Masse A, et al. Rehabilitation protocol following hip arthroscopy. A 2015 to 2020 systematic review. Am J Phys Med Rehabil. 2020;Publish Ahead of Print.
86. Almasri M, Simunovic N, Heels-Ansdell D, Ayeni OR, Investigators F. Femoroacetabular impingement surgery leads to early pain relief but minimal functional gains past 6 months: experience from the FIRST trial. Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 2021;29(5):1362-9.

87. Domb BG, Stake CE, Finch NA, Cramer TL. Return to sport after hip arthroscopy: aggregate recommendations from high-volume hip arthroscopy centers. Orthopedics. 2014;37(10):e902-5.
88. Freke MD, Crossley K, Sims K, Russell T, Weinrauch P, Gamboa G, et al. Acute and Subacute Changes in Hip Strength and Range of Movement After Arthroscopy to Address Chondrolabral Pathology. The American journal of sports medicine. 2019;47(8):1939-48.
89. Reiman MP, Peters S, Sylvain J, Hagymasi S, Mather RC, Goode AP. Femoroacetabular impingement surgery allows 74% of athletes to return to the same competitive level of sports participation but their level of performance remains unreported: a systematic review with meta-analysis. British journal of sports medicine. 2018.
90. Ardern CL, Taylor NF, Feller JA, Webster KE. Fifty-five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: an updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. British journal of sports medicine. 2014;48(21):1543-52.
91. Jack RA, 2nd, Sochacki KR, Hirase T, Vickery JW, Harris JD. Performance and Return to Sport After Hip Arthroscopy for Femoroacetabular Impingement in Professional Athletes Differs Between Sports. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2019;35(5):1422-8.
92. Ishoi L, Thorborg K, Kraemer O, Holmich P. Return to Sport and Performance After Hip Arthroscopy for Femoroacetabular Impingement in 18- to 30-Year-Old Athletes: A Cross-sectional Cohort Study of 189 Athletes. The American journal of sports medicine. 2018;46(11):2578-87.
93. Ishoi L, Thorborg K, Orum MG, Kemp JL, Reiman MP, Holmich P. How Many Patients Achieve an Acceptable Symptom State After Hip Arthroscopy for Femoroacetabular Impingement Syndrome? A Cross-sectional Study Including PASS Cutoff Values for the HAGOS and iHOT-33. Orthop J Sports Med. 2021;9(4):2325967121995267.
94. Kierkegaard S, Dalgas U, Lund B, Lipperts M, Soballe K, Mechlenburg I. Despite patient-reported outcomes improve, patients with femoroacetabular impingement syndrome do not increase their objectively measured sport and physical activity level 1 year after hip arthroscopic surgery. Results from the HAFAI cohort. Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 2020;28(5):1639-47.
95. Palsson A, Kostogiannis I, Lindvall H, Ageberg E. Hip-related groin pain, patient characteristics and patient-reported outcomes in patients referred to tertiary care due to longstanding hip and groin pain: a cross-sectional study. BMC musculoskeletal disorders. 2019;20(1):432.
96. Arokoski MH, Haara M, Helminen HJ, Arokoski JP. Physical function in men with and without hip osteoarthritis. Arch Phys Med Rehabil. 2004;85(4):574-81.
97. Bastick AN, Damen J, Agricola R, Brouwer RW, Bindels PJ, Bierma-Zeinstra SM. Characteristics associated with joint replacement in early symptomatic knee or hip

osteoarthritis: 6-year results from a nationwide prospective cohort study (CHECK). Br J Gen Pract. 2017;67(663):e724-e31.

98. Kemp JL, Makdissi M, Schache AG, Finch CF, Pritchard MG, Crossley KM. Is quality of life following hip arthroscopy in patients with chondrolabral pathology associated with impairments in hip strength or range of motion? Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA. 2016;24(12):3955-61.
99. Minkara AA, Westermann RW, Rosneck J, Lynch TS. Systematic Review and Meta-analysis of Outcomes After Hip Arthroscopy in Femoroacetabular Impingement. The American journal of sports medicine. 2019;47(2):488-500.
100. Charlton PC, Bryant AL, Kemp JL, Clark RA, Crossley KM, Collins NJ. Single-Leg Squat Performance is Impaired 1 to 2 Years After Hip Arthroscopy. PM & R : the journal of injury, function, and rehabilitation. 2016;8(4):321-30.
101. Kemp JL, Risberg MA, Schache AG, Makdissi M, Pritchard MG, Crossley KM. Patients With Chondrolabral Pathology Have Bilateral Functional Impairments 12 to 24 Months After Unilateral Hip Arthroscopy: A Cross-sectional Study. The Journal of orthopaedic and sports physical therapy. 2016;46(11):947-56.
102. Kemp JL, Schache AG, Makdissia M, Pritchard MG, Sims K, Crossley KM. Is hip range of motion and strength impaired in people with hip chondrolabral pathology? Journal of musculoskeletal & neuronal interactions. 2014;14(3):334-42.
103. Kierkegaard S, Mechlenburg I, Lund B, Romer L, Soballe K, Dalgas U. Is hip muscle strength normalised in patients with femoroacetabular impingement syndrome one year after surgery?: Results from the HAFAI cohort. Journal of science and medicine in sport / Sports Medicine Australia. 2019;22(4):413-9.
104. Larson CM, Safran MR, Brcka DA, Vaughn ZD, Giveans MR, Stone RM. Predictors of Clinically Suspected Intra-articular Hip Symptoms and Prevalence of Hip Pathomorphologies Presenting to Sports Medicine and Hip Preservation Orthopaedic Surgeons. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2018;34(3):825-31.
105. Ishoi L, Thorborg K, Kemp JL, Reiman MP, Holmich P. Maximal hip muscle strength and rate of torque development 6-30months after hip arthroscopy for femoroacetabular impingement syndrome: A cross-sectional study. Journal of science and medicine in sport / Sports Medicine Australia. 2021.
106. Kierkegaard S, Mechlenburg I, Lund B, Soballe K, Dalgas U. Impaired hip muscle strength in patients with femoroacetabular impingement syndrome. Journal of science and medicine in sport / Sports Medicine Australia. 2017;20(12):1062-7.
107. Webster KE, Feller JA, Lambros C. Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine. 2008;9(1):9-15.
108. Webster KE, McPherson AL, Hewett TE, Feller JA. Factors Associated With a Return to Preinjury Level of Sport Performance After Anterior Cruciate Ligament Reconstruction Surgery. The American journal of sports medicine. 2019;47(11):2557-62.

109. Kvist J, Osterberg A, Gauffin H, Tagesson S, Webster K, Ardern C. Translation and measurement properties of the Swedish version of ACL-Return to Sports after Injury questionnaire. Scandinavian journal of medicine & science in sports. 2013;23(5):568-75.
110. Jones DM, Webster KE, Crossley KM, Ackerman IN, Hart HF, Singh PJ, et al. Psychometric Properties of the Hip-Return to Sport After Injury Scale (Short Form) for Evaluating Psychological Readiness to Return to Sports After Arthroscopic Hip Surgery. The American journal of sports medicine. 2020;48(2):376-84.
111. Sandon A, Engstrom B, Forssblad M. High Risk of Further Anterior Cruciate Ligament Injury in a 10-Year Follow-up Study of Anterior Cruciate Ligament-Reconstructed Soccer Players in the Swedish National Knee Ligament Registry. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association. 2020;36(1):189-95.
112. Prinsen CAC, Mokkink LB, Bouter LM, Alonso J, Patrick DL, de Vet HCW, et al. COSMIN guideline for systematic reviews of patient-reported outcome measures. Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation. 2018;27(5):1147-57.
113. O'Connor RF, King E, Richter C, Webster KE, Falvey EC. No Relationship Between Strength and Power Scores and Anterior Cruciate Ligament Return to Sport After Injury Scale 9 Months After Anterior Cruciate Ligament Reconstruction. The American journal of sports medicine. 2020;48(1):78-84.
114. Tijssen M, van Cingel R, de Visser E, Nijhuis-van der Sanden M. A clinical observational study on patient-reported outcomes, hip functional performance and return to sports activities in hip arthroscopy patients. Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine. 2016;20:45-55.

Appendix 1a

Nuvarande rehabiliteringsstrategier för patienter efter höftartroskopi i Skandinavien – En undersökning av fysioterapeuter och ortopedkirurger i Sverige, Danmark och Norge

Tack för visat intresse för undersökningen.

Det ökande antalet utförda höftartroskopier i Skandinavien och över hela världen leder till en ökning av antalet patienter som behöver postoperativ rehabilitering. I syfte att beskriva gällande klinisk praxis för rehabilitering efter höftartroskopi, söker vi ortopedkirurger och fysioterapeuter med erfarenhet av höftartroskopi. Vi är intresserade av din kliniska erfarenhet och värdesätter dina åsikter och perspektiv.

Denna enkät skickas ut till fysioterapeuter som du i Sverige, Danmark och Norge. Tillsammans, och med din medverkan, hoppas vi kunna belysa detta område som hittills är dåligt utforskat och därmed underlätta insatserna för att förbättra rehabiliterande vård av patienter efter en höftartroskopi. Enkäten tar cirka 15 minuter att fylla i.

Ditt deltagande i undersökningen är frivilligt och du har rätt att avstå från att delta när som helst utan att uppge någon orsak. Dina svar kommer att behandlas på ett sådant sätt att ingen obehörig person kommer att ha tillgång till dem. Dina personliga uppgifter kommer att behandlas enligt personuppgiftslagen (1998:204). Resultaten från studien avses att publiceras i en expertgranskad tidskrift och göras tillgängligt för allmänheten. Som deltagare i studien kommer du på begäran att få ta del av resultatet (kontakta Tobias Wörner på: tobias.worner@med.lu.se

Denna undersökning ingår i ett doktorandprojekt om rehabilitering efter artroskopi [Student: Tobias Wörner (Lunds universitet); Huvudhandledare: Frida Eek (Lunds universitet); Bihandledare: Kristian Thorborg (Köpenhamns universitet)]. Medverkande i Norge är Håvard Moksnes (Oslo Sports Trauma Research Center). För mer information om studien vänligen kontakta Tobias Wörner på: tobias.worner@med.lu.se

---

How to fill in the paper survey

Below you can see how you mark an answer option in the check boxes, and how you change a selection.

☒ The answer option has been marked correctly

☒ The answer option has been marked incorrectly, the cross must be in the middle of the box

☒ The answer option has been marked incorrectly, the cross is too strong

☒ Changed selection, the answer option will not be counted as being marked

Undersökning

Följande undersökning består av högst **27 korta frågor** gällande din kliniska expertis, din arbetsmiljö och specifika aspekter av rehabiliteringsprocessen efter höftartroskopi.

Patientgruppen som genomgår höftartroskopi är inte homogen när det gäller specifika kirurgiska indikationer, vilket kan påverka svaren på ett antal frågor. **Vi ber dig därför att ha en typisk höftartroskopipatient i åtanke när du besvarar frågorna 8-25: 25-40 år gammal med femuroacetabulär impingement och chondral/labrum skada.**

På grund av filtrerade frågor kan webfönstret ibland hoppa ner en bit för långt. Om det händer kan du behöva scrolla upp för att ta vid där du slutade.

1. Kön

☐ Man

☐ Kvinna

2. Namn på kliniken där du arbetar

3. Arbetar du inom privat eller offentlig sektor?

☐ Privat sektor

☐ Offentlig sektor

☐ Både privat och offentlig sektor

4. Arbetar du inom den primär- eller specialist-vård?

☐ Primärvård

☐ Specialistvård

5. Erbjuder kliniken där du arbetar både kirurgi och rehabilitering?

☐ Ja

☐ Nej

6. För hur många år sedan behandlade du din första höftartroskopipatient?

7. Hur många höftartroskopipatienter har du behandlat i genomsnitt per år sedan dess?

Vänligen svara på följande frågor utifrån ett scenario gällande en typisk höftartroskopipatient:

25-40 år gammal med femuroacetabulär impingement och chondral/labrum skada.

8. Hur viktigt bedömer du att fysioterapi är för rehabiliteringen efter höftartroskopi?

- ☐ Inte alls viktigt
- ☐ Lite viktigt
- ☐ Ganska viktigt
- ☐ Mycket viktigt
- ☐ Extremt viktigt

9. Är dina höftartroskopipatienter remitterade till dig eller har de kommit själv, utan remiss?

- ☐ Remitterade
- ☐ Utan remiss
- ☐ Både med remitterade och utan remiss

10. Följer du ett visst rehabiliteringsprotokoll?

- ☐ Ja
- ☐ Nej

11. Vem utvecklade protokollet?

- ☐ Min klinik
- ☐ Jag själv
- ☐ Vet inte
- ☐ Andra

Om andra, ange vilka

12. Följer rehabiliteringsprotokollet en tidsbaserad eller resultatbaserad behandlingsprogression?

- ☐ Tidsbaserad
- ☐ Resultatbaserad
- ☐ Kombinerad tids- och resultatbaserad
- ☐ Vet inte

13. Följer du en tidsbaserad eller resultatbaserad progression under rehabiliteringen?

☐ Tidsbaserad

☐ Resultatbaserad

☐ Kombinerad tids- och resultatbaserad

14. Utvärderar du dina höftartroskopipatienters behandlingsresultat?

	Aldrig	Ibland	Alltid
Subjektiva mätningar (patientrapporterade)	☐	☐	☐
Objektiva mätningar (mätta av dig)	☐	☐	☐

15. Använder du något av följande subjektiva utfallsmått avseende dina höftartroskopipatienter?

	Ja	Nej
Hip And Groin Outcome Score (HAGOS)	☐	☐
Hip Outcome Score (HOS)	☐	☐
International Hip Outcome Tool (iHOT12 /iHOT33)	☐	☐
Visual Analog Scale (VAS)	☐	☐
Numeric Rating Scale (NRS)	☐	☐
Other	☐	☐

Om andra, vänligen uppge

16. Använder du något av följande objektiva utfallsmått avseende dina höftartroskopipatienter?

	Ja	Nej
Rörelseomfång	☐	☐
Styrka	☐	☐
Prestationsbaserade (funktionella) mätningar	☐	☐
Andra	☐	☐

Om andra, vänligen uppge vilka

17. Hur lång tid tar det, enligt din erfarenhet, innan en höftartroskopipatient kan återgå till arbetet?

	Minst antal veckor	Maximalt antal veckor	Genomsnittligt antal veckor
Fysiskt krävande arbete (t.ex. byggnadsarbete)			
Arbete som inte är fysiskt krävande (t.ex.			

18. Hur lång tid tar det, enligt din erfarenhet, innan en höftartroskopipatient kan utföra önskade fysiska aktiviteter?

	Minst antal veckor	Maximalt antal veckor	Genomsnittligt antal veckor
Motionsnivå			
Tävlingsnivå			

19. I vilken utsträckning, enligt din erfarenhet, påverkar följande personer beslutet att återuppta idrott efter en höftartroskopi?

	Inte alls inflytelserik	Lite inflytelserik	Ganska inflytelserik	Mycket inflytelserik	Extremt inflytelserik
Patienten	☐	☐	☐	☐	☐
Fysioterapeuten	☐	☐	☐	☐	☐
Kirurgen	☐	☐	☐	☐	☐

Om andra är involverade i beslutet, vänligen ange vilka:

20. Utvärderar du om patienten är redo för att återuppta idrott efter en höftartroskopi?

☐ Ja

☐ Nej

21. Hur mycket påverkar följande aspekter din utvärdering av om patienten är redo att återuppta idrott efter en höftartroskopi?

	Inte alls inflytelserik	Lite inflytelserik	Ganska inflytelserik	Mycket inflytelserik	Extremt inflytelserik
Rörelseomfång	☐	☐	☐	☐	☐
Styrka	☐	☐	☐	☐	☐
Psykologisk beredskap (t.ex. rädsla för att skadas igen)	☐	☐	☐	☐	☐
Smärta	☐	☐	☐	☐	☐
Prestationsbaserat (funktionella mätningar)	☐	☐	☐	☐	☐

Om du använder en särskild prestationsbaserad / funktionell mätning, vänligen ange vilken:

22. Rekommenderar du höftartroskopipatienter att begränsa sitt rörelseomfång under rehabiliteringen?

	Ja	Nej
Flexion	☐	☐
Extension	☐	☐
Abduktion	☐	☐
Adduktion	☐	☐
Inåtrotation	☐	☐
Utåtrotation	☐	☐

Om du rekommenderar begränsning av några av ovanstående rörelser, ange vilka (hur/när)

23. Hur länge skulle du rekommendera en höftatroskopipatient att:

	Minst antal veckor	Maximalt antal veckor	Genomsnittligt antal veckor
Använda kryckor			
Avstå från löpning			
Avstå från aktiviteter inklusive snabba			

24. Hur viktiga bedömer du att följande behandlingsformer är i rehabiliteringsprocessen?

	Inte alls viktiga	Lite viktiga	Ganska viktiga	Mycket viktiga	Extremt viktiga
Träningsterapi	☐	☐	☐	☐	☐
Manuell terapi	☐	☐	☐	☐	☐
Elektrofysikaliska modaliteter	☐	☐	☐	☐	☐

25. Hur ofta träffar du dina höftartroskopipatienter för behandling (besök per månad)?

Minst	
Maximalt	
Genomsnittligt	

26. Är du intresserad av att delta i ett potentiellt skandinaviskt nätverk av fysioterapeuterna engagerade i rehabilitering efter höftartroskopi?

☐ Ja

☐ Nej

27. Vänligen ange den e-postadress som du vill bli kontaktad på

Appendix 1b

Nuvarande rehabiliteringsstrategier för patienter efter höftartroskopi i Skandinavien – En undersökning av fysioterapeuter och ortopedkirurger i Sverige, Danmark och Norge

Tack för visat intresse för undersökningen.

Det ökande antalet utförda höftartroskopier i Skandinavien och över hela världen leder till en ökning av antalet patienter som behöver postoperativ rehabilitering. I syfte att beskriva gällande klinisk praxis för rehabilitering efter höftartroskopi, söker vi ortopedkirurger och fysioterapeuter med erfarenhet av höftartroskopi. Vi är intresserade av din kliniska erfarenhet och värdesätter dina åsikter och perspektiv.

Denna enkät delas ut till läkare som du i Sverige, Danmark och Norge. Du identifierades via kontaktuppgifter från nationella och/eller skandinaviska sammanträden avseende höftartroskopi eller via ditt arbete på en klinik som finns listad i det nationella artroskopiregistret och är därmed berättigad till att delta i den här undersökningen. Tillsammans, och med din medverkan, hoppas vi kunna belysa detta område som hittills är dåligt utforskat och därmed underlätta insatserna för att förbättra rehabiliterande vård av patienter efter en höftartroskopi. Enkäten tar cirka 15 minuter att fylla i.

Ditt deltagande i undersökningen är frivilligt och du har rätt att avstå från att delta när som helst utan att uppge någon orsak. Dina svar kommer att behandlas på ett sådant sätt att ingen obehörig person kommer att ha tillgång till dem. Dina personliga uppgifter kommer att behandlas enligt personuppgiftslagen (1998:204). Resultaten från studien avses att publiceras i en expertgranskad tidskrift och göras tillgängligt för allmänheten. Som deltagare i studien kommer du på begäran att få ta del av resultatet (kontakta Tobias Wörner på: tobias.worner@med.lu.se

Denna undersökning ingår i ett doktorandprojekt om rehabilitering efter artroskopi [Student: Tobias Wörner (Lunds universitet); Huvudhandledare: Frida Eek (Lunds universitet); Bihandledare: Kristian Thorborg (Köpenhamns universitet)]. Medverkande i Norge är Håvard Moksnes (Oslo Sports Trauma Research Center). För mer information om studien vänligen kontakta Tobias Wörner på: tobias.worner@med.lu.se

---

Så här fyller du i pappersenkäten
Nedan ser du hur du markerar ett svarsalternativ, och hur du avmarkerar ett redan gjort val.

☒ Korrekt markerat svarsalternativ

☒ Inkorrekt markerat svarsalternativ, krysset ska vara mitt i rutan

☒ Inkorrekt markerat svarsalternativ, krysset är alltför kraftigt

☒ Ångrat val, svarsalternativet räknas inte som markerat

Undersökning

Följande undersökning består av högst **27 korta frågor** gällande din kliniska expertis, din arbetsmiljö och specifika aspekter av rehabiliteringsprocessen efter höftartroskopi.

Patientgruppen som genomgår höftartroskopi är inte homogen när det gäller specifika kirurgiska indikationer, vilket kan påverka svaren på ett antal frågor. **Vi ber dig därför att ha en typisk höftartroskopipatient i åtanke när du besvarar frågorna 8-25: 25-40 år gammal med femuroacetabulär impingement och chondral/labrum skada.**

På grund av filtrerade frågor kan webfönstret ibland hoppa ner en bit för långt. Om det händer kan du behöva scrolla upp för att ta vid där du slutade.

1. Kön

☐ Man

☐ Kvinna

2. Namn på kliniken där du arbetar

3. Arbetar du inom privat eller offentlig sektor?

☐ Privat sektor

☐ Offentlig sektor

☐ Både privat och offentlig sektor

4. Arbetar du inom primär- eller specialistvård?

☐ Primärvård

☐ Specialistvård

5. Erbjuder kliniken där du arbetar både kirurgi och rehabilitering?

☐ Ja

☐ Nej

6. För hur många år sedan behandlade du din första höftartroskopipatient?

7. Hur många höftartroskopipatienter har du behandlat i genomsnitt per år sedan dess?

Vänligen svara på följande frågor när det gäller en typisk höftartroskopipatient:
25-40 år gammal med femuroacetabulär impingement och chondral/labrum skada.

8. Hur viktigt bedömer du att fysioterapi är för rehabiliteringen efter höftartroskopi?

- ☐ Inte alls viktigt
- ☐ Lite viktigt
- ☐ Ganska viktigt
- ☐ Mycket viktigt
- ☐ Extremt viktigt

9. Remitterar du dina höftartroskopipatienter till en fysioterapeut?

- ☐ Ja alltid
- ☐ Ja ibland
- ☐ Aldrig

10. Vilket är ditt huvudsakliga skäl till att du inte remitterar dina höftartroskopipatienter till en fysioterapeut?

- ☐ Det behövs inte
- ☐ Behandling baserad i hemmet (utan fysioterapeut) är lika effektiv
- ☐ Jag vet inte
- ☐ Andra (vänligen ange vilka)

Ange

11. Remitterar du dina höftartroskopipatienter för rehabilitering till en specifik rehabiliteringsklinik och/eller fysioterapeut?

☐ Nej

☐ Ja

Om ja, vilken klinik/fysioterapeut remitterar du dina patienter till?

12. Rekommenderar du att fysioterapeuten ska följa ett visst rehabiliteringsprotokoll?

☐ Ja

☐ Nej

13. Vem utvecklade protokollet?

☐ Min klinik

☐ Jag själv

☐ Vet inte

☐ Andra

Om andra, ange vilka

14. Följer rehabiliteringsprotokollet en tidsbaserad eller resultatbaserad progression?

☐ Tidsbaserad

☐ Resultatbaserad

☐ Kombinerad tids- och resultatbaserad

☐ Vet inte

15. Rekommenderar du att fysioterapeuten ska följa en tidsbaserad eller resultatbaserad behandlingsprogression?

☐ Tidsbaserad

☐ Resultatbaserad

☐ Kombinerad tids- och resultatbaserad

☐ Jag ger inte några rekommendationer avseende progression

16. Utvärderar du dina höftartroskopipatienters behandlingsresultat?

	Aldrig	Ibland	Alltid
Subjektiva mätningar (patientrapporterade)	☐	☐	☐
Objektiva mätningar (mätta av dig)	☐	☐	☐

17. Använder du något av följande subjektiva utfallsmått avseende dina höftartroskopipatienter?

	Ja	Nej
Hip And Groin Outcome Score (HAGOS)	☐	☐
Hip Outcome Score (HOS)	☐	☐
International Hip Outcome Tool (iHOT /iHOT33)	☐	☐
Visual Analogue Scale (VAS)	☐	☐
Numeric Rating Scale (NRS)	☐	☐

Om andra, vänligen uppge vilka

18. Använder du något av följande objektiva utfallsmått avseende dina höftartroskopipatienter?

	Ja	Nej
Rörelseomfång	☐	☐
Styrka	☐	☐
Prestationsbaserade (funktionella) mätningar	☐	☐
Andra	☐	☐

Om andra, vänligen uppge vilka

19. Hur lång tid tar det, enligt din erfarenhet, innan en höftartroskopipatient kan återgå till arbetet?

	Minst antal veckor	Maximalt antal veckor	Genomsnittligt antal veckor
Fysiskt krävande arbete (t.ex. byggnadsarbete)			
Arbete som inte är fysiskt krävande (t.ex.			

20. Hur lång tid tar det, enligt din erfarenhet, innan en höftartroskopipatient kan utföra önskade fysiska aktiviteter?

	Minst antal veckor	Maximalt antal veckor	Genomsnittligt antal veckor
Motionsnivå			
Tävlingsnivå			

21. I vilken utsträckning, enligt din erfarenhet, påverkar följande personer beslutet att återuppta idrott efter en höftartroskopi?

	Inte alls inflytelserik	Lite inflytelserik	Ganska inflytelserik	Mycket inflytelserik	Extremt inflytelserik
Patienten	☐	☐	☐	☐	☐
Fysioterapeuten	☐	☐	☐	☐	☐
Kirurgen	☐	☐	☐	☐	☐

Om andra är involverade i beslutet, vänligen ange vilka:

22. Utvärderar du om patienten är redo för att återuppta idrott efter en höftartroskopi?

☐ Ja

☐ Nej

23. Hur mycket påverkar följande aspekter din utvärdering av om patienten är redo att återuppta idrott efter en höftartroskopi?

	Inte alls inflytelserik	Lite inflytelserik	Ganska inflytelserik	Mycket inflytelserik	Extremt inflytelserik
Rörelseomfång	☐	☐	☐	☐	☐
Styrka	☐	☐	☐	☐	☐
Psykologisk beredskap (t.ex. rädsla för att skadas igen)	☐	☐	☐	☐	☐
Smärta	☐	☐	☐	☐	☐
Prestationsbaserat (funktionella mätningar)	☐	☐	☐	☐	☐

Om du använder en särskild prestationsbaserad / funktionell mätning, vänligen ange vilken:

24. Rekommenderar du höftartroskopipatienter att begränsa sitt rörelseomfång under rehabiliteringen?

	Ja	Nej
Flexion	☐	☐
Extension	☐	☐
Abduktion	☐	☐
Adduktion	☐	☐
Inåtrotation	☐	☐
Utåtrotation	☐	☐

Om du rekommenderar begränsning av några av ovanstående rörelser, ange vilka (hur/när)

25. Hur länge skulle du rekommendera en höftatroskopipatient att:

	Minst antal veckor	Maximalt antal veckor	Genomsnittligt antal veckor
Använda kryckor			
Avstå från löpning			
Avstå från aktiviteter inklusive snabba			

26. Hur viktiga bedömer du att följande behandlingsformer är i rehabiliteringsprocessen?

	Inte alls viktiga	Lite viktiga	Ganska viktiga	Mycket viktiga	Extremt viktiga
Träningsterapi	☐	☐	☐	☐	☐
Manuell terapi	☐	☐	☐	☐	☐
Elektrofysikaliska modaliteter	☐	☐	☐	☐	☐

Andra:

27. Hur ofta träffar du dina höftartroskopipatienter för uppföljning efter en operation? (Totalt antal uppföljningar)

Appendix 2

Nedanstående enkät består av några bakgrundsfrågor samt frågor relaterade till a) din rehabiliteringsupplevelse b) din vardagliga och idrottsrelaterade höftfunktion c) din eventuella återgång till idrott/fysiskt aktivitet.

Det tar ca 10 minuter att svara på enkäten.

Tack för din medverkan!

Så här fyller du i pappersenkäten
Nedan ser du hur du markerar ett svarsalternativ, och hur du avmarkerar ett redan gjort val.

☒ Korrekt markerat svarsalternativ

☒ Inkorrekt markerat svarsalternativ, krysset ska vara mitt i rutan

☒ Inkorrekt markerat svarsalternativ, krysset är alltför kraftigt

☒ Ångrat val, svarsalternativet räknas inte som markerat

Bakgrundsfrågor

Kön

☐ Man

☐ Kvinna

Ålder

_____

Vilken höft har du opererat?

☐ Höger

☐ Vänster

☐ Först höger sedan vänster

☐ Först vänster sedan höger

☐ Vänster och höger samtidigt

Har du genomgått någon annan operation efter din höftoperation?

☐ Ja

☐ Nej

Vilken typ av operation?

_____

Har du, efter din höftoperation, haft någon annan skada som du sökt vård för/som har begränsat dig i ditt idrottsutövande/aktivitetsnivå?

☐ Ja

☐ Nej

Vilken typ av skada?

Vilken var din huvudsakliga idrott/fysiska aktivitet (om tilllämpligt) innan din höftoperation?

Upplevelse av rehabiliteringsprocessen

Hur upplever du resultatet av din höftartroskopi, totalt sett?

☐ Mycket dåligt

☐ Ganska dåligt

☐ Varken bra eller dåligt

☐ Ganska bra

☐ Mycket bra

Skulle du rekommendera en vän med liknande symptom som du haft, att genomgå en höftartroskopi?

☐ Ja

☐ Nej

☐ Jag vet inte

Hur upplever/upplevde du rehabiliteringsprocessen efter din höftartroskopi?

☐ Mycket dåligt

☐ Ganska dåligt

☐ Varken bra eller dåligt

☐ Ganska bra

☐ Mycket bra

☐ Jag fick ingen strukturerad rehabilitering

Var genomförde du din rehabilitering?

☐ Vårdcentral

☐ Fysioterapimottagning utan speciell inriktning

☐ Fysioterapimottagning med inriktning mod Idrottsmedicin

☐ Någon annanstans / vet ej

Ange i vilken grad du instämmer i följande påståenden:

Behandlingen i sig (operation och efterföljande rehabilitering) levde upp till mina förväntningar

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Resultatet av behandlingen (höftartroskopin och efterföljande rehabilitering) levde upp till mina förväntningar

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Jag upplevde att min fysioterapeut hade god kunskap om min diagnos och post-operativa behandling

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Har/hade du regelbundna möten med en fysioterapeut (sjukgymnast) under din rehabilitering efter höftartroskopin?

- ☐ Nej
- ☐ Bara några gånger
- ☐ Ja, genom hela rehabiliteringen

Formulerade du specifika rehabiliteringsmål tillsammans med din fysioterapeut?

- ☐ Ja
- ☐ Nej
- ☐ Kommer inte ihåg/vet ej

Uppnådde du de mål du formulerade tillsammans med din fysioterapeut?

☐ Inte alls

☐ Till viss del

☐ Ja, till fullo

☐ Jag kommer inte ihåg/vet ej

Uppnådde du dina personliga rehabiliteringsmål?

☐ Inte alls ☐ Till viss del ☐ Ja, till fullo ☐ Jag hade inga personliga mål

☐ Jag kommer inte ihåg

Ange i vilken grad du instämmer i följande påståenden:

Jag upplever att fysipterapeuten har haft tid med mig när jag behövt det.

☐ Tar helt avstånd

☐ Tar delvis avstånd

☐ Varken instämmer eller tar avstånd

☐ Instämmer delvis

☐ Instämmer helt

Jag upplever att kirurgen har haft tid med mig när jag behövt det.

☐ Tar helt avstånd

☐ Tar delvis avstånd

☐ Varken instämmer eller tar avstånd

☐ Instämmer delvis

☐ Instämmer helt

Jag upplever att kirurgen och fysioterapeuten samarbetat väl gällande min behandling.

☐ Tar helt avstånd

☐ Tar delvis avstånd

☐ Varken instämmer eller tar avstånd

☐ Instämmer delvis

☐ Instämmer helt

Jag har haft möjlighet att påverka beslut gällande min rehabilitering.

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Jag fick tillräcklig information avseende min diagnos inför min höftoperation.

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Jag fick tillräcklig information avseende det kirurgiska ingreppet inför min höftoperation.

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Jag fick tillräcklig information avseende den efterföljande rehabiliteringen, inför min höftoperation

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Behandlingen i sig (operation och efterföljande rehabilitering) levde upp till mina förväntningar

- ☐ Tar helt avstånd
- ☐ Tar delvis avstånd
- ☐ Varken instämmer eller tar avstånd
- ☐ Instämmer delvis
- ☐ Instämmer helt

Jag fick tillräcklig information avseende risken för möjliga bakslag under rehabiliteringen, inför min höftoperation.

☐ Tar helt avstånd

☐ Tar delvis avstånd

☐ Varken instämmer eller tar avstånd

☐ Instämmer delvis

☐ Instämmer helt

Informationen jag fick förmedlades på ett förståeligt sätt.

☐ Tar helt avstånd

☐ Tar delvis avstånd

☐ Varken instämmer eller tar avstånd

☐ Instämmer delvis

☐ Instämmer helt

iHOT12

INSTRUKTIONER

- Dessa frågor handlar om de besvär som du kan uppleva i din höft, hur dessa besvär påverkar ditt liv och de känslor du känner som följd av dessa besvär.

- Vänligen ange svårighetsgraden av dina höftbesvär genom att markera linjen med ett streck nedanför varje fråga

» Om du markerar längst ut till vänster betyder det att du känner dig påtagligt begränsad.

» Om du markerar längst ut till höger betyder det att du inte har några problem alls med din höft.

» Om markeringen placeras mitt på linjen betyder det att du är måttligt besvärad, eller med andra ord, mitt emellan 'påtagligt begränsad' och 'inga problem alls'. Det är viktigt att du markerar ända ut i kanten av linjen om det är ytterligheten som bäst beskriver din situation.

OBS Markören behöver röras aktivt för att ett svar ska registreras, om du vill markera påtagliga /maximala besvär behöver du alltså ändå röra markören innan du placerar den längst ut till vänster.

TIPS Om du inte utför en aktivitet, föreställ dig hur det skulle kännas i din höft om du var tvungen att utföra aktiviteten.

- Vänligen låt dina svar beskriva den typiska situationen senaste månaden.

Vilken höft handlar detta formulär om? Om vi bett dig att ge svar om en specifik höft, markera den. Annars markera den höft som ger dig mest besvär.

☐ Vänster

☐ Höger

Totalt sett, hur mycket smärta har du i din höft/ljumske?

Hur svårt är det för dig att ta dig ner på och upp från golvet/marken?

Hur svårt är det för dig att gå långa distanser?

Hur mycket besvär har du av krasningar, upphakningar eller klickande i din höft?

Hur mycket besvär har du av att knuffa, dra, lyfta eller bära tunga föremål?

Hur oroad är du över riktningsförändringar när du idrottar eller motionerar?

Hur mycket smärta har du i din höft efter aktivitet?

Hur oroad är du över att lyfta upp och bära barn på grund av din höft?

Hur mycket besvär har du med sexuella aktiviteter på grund av din höft?

Hur mycket tid är du medveten om dina besvär med din höft?

Hur oroad är du över din möjlighet att upprätthålla din önskade fysiska nivå?

Hur distraherande/störande är dina höftproblem?

HAGOS

VÄGLEDNING: Detta frågeformulär innehåller frågor om hur din höft och/eller ljumske fungerar. Du skall ange hur din höft och/eller ljumske har fungerat under **den senaste veckan**. Svaren skall hjälpa oss att kunna förstå hur du har det och hur bra du klarar dig i vardagen.

Du skall besvara frågorna genom att kryssa för det alternativ som passar dig bäst. Du skall endast ange ett kryss för varje fråga. Du skall svara på alla frågorna. Om en fråga inte gäller dig eller om du inte upplevt besväret under den senaste veckan, så ange det alternativ som passar bäst in och som du känner dig mest nöjd med.

Funktion, sport och fritid

Följande frågor handlar om din fysiska förmåga. Du skall svara på ALLA frågor. Om en fråga inte gäller dig eller om du inte upplevt besväret under den senaste veckan, så ange det alternativ som passar bäst in och som du känner dig mest nöjd med. **Ange vilken grad av besvär du har haft i följande aktiviteter under den senaste veckan, på grund av problem med din höft och/eller ljumske.**

Sitta på huk

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

Springa

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

Vrida/snurra kroppen när du står på benet

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

Gå på ojämnt underlag

- [ ] Inga
- [ ] Lätta
- [ ] Måttliga
- [ ] Stora
- [ ] Mycket stora

Springa så snabbt du kan

- [ ] Inga
- [ ] Lätta
- [ ] Måttliga
- [ ] Stora
- [ ] Mycket stora

Föra benet framåt kraftigt och/eller till sidan, exempelvis som vid en spark, skridskosteg eller liknande

- [ ] Inga
- [ ] Lätta
- [ ] Måttliga
- [ ] Stora
- [ ] Mycket stora

Plötsliga, explosiva rörelser som involverar snabba fotrörelser, exempelvis accelerationer, uppbromsningar, riktningsförändringar eller liknande

- [ ] Inga
- [ ] Lätta
- [ ] Måttliga
- [ ] Stora
- [ ] Mycket stora

Situationer där benet rör sig helt ut i ytterläge (med ytterläge menas så långt ut från kroppen som möjligt)

- [ ] Inga
- [ ] Lätta
- [ ] Måttliga
- [ ] Stora
- [ ] Mycket stora

Delta i fysisk aktivitet

Följande frågor handlar om din förmåga att delta i fysiska aktiviteter. Med fysiska aktiviteter menas idrottsaktiviteter, men även andra aktiviteter, där man blir lätt andfådd. **Ange i vilken grad din förmåga att delta i önskade fysiska aktiviteter har varit påverkade under senaste veckan, på grund av dina problem med din höft och/eller ljumske.**

Kan du delta i önskade fysiska aktiviteter så länge du vill?

- ☐ Alltid
- ☐ Ofta
- ☐ Ibland
- ☐ Sällan
- ☐ Aldrig

Kan du delta i önskade fysiska aktiviteter på din normala prestationsnivå?

- ☐ Alltid
- ☐ Ofta
- ☐ Ibland
- ☐ Sällan
- ☐ Aldrig

HSAS (Hip Sports Activity Scale - Swedish)

Uppskatta din aktivitetsnivå vid olika tidpunkter enligt skalan 0-8 som anges nedan. Ange den siffra som stämmer bäst för dig utifrån den klassificering av olika idrottsaktiviteter och -nivåer som anges i beskrivning av skalan nedanför frågorna.

Uppskatta din nuvarande aktivitetsnivå (enligt skalan som beskrivs nedan).

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8

Uppskatta din aktivitetsnivå (enligt skalan som beskrivs nedan) som den var innan du fick symptom från höften.

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8

8
Tävlingsidrott (nationell och internationell elitnivå):

Fotboll, Ishockey, Innebandy, Kampsport, Tennis, Friidrott, Inomhusidrottsaktiviteter*, Beachvolleyboll

7
Tävlingsidrott (nationell och internationell elitnivå)

Alpin skidåkning, Snowboard, Konståkning, Skridsko, Dans

Tävlingsidrott (lägre divisioner)

Fotboll, Ishockey, Innebandy, Kampsport, Tennis, Friidrott, Inomhusidrottsaktiviteter*, Beachvolleyboll

6
Tävlingsidrott (nationell och internationell elitnivå)

Golf, Cykel, Mountainbike, Simning, Rodd, Längdskidåkning, Ridning

Tävlingsidrott (lägre divisioner)

Alpin skidåkning, Snowboard, Konståkning, Skridsko, Dans

5
Tävlingsidrott (lägre divisioner)

Golf, Cykel, Mountainbike, Simning, Rodd, Längdskidåkning, Ridning

Motionsidrott

Ishockey, Innebandy, Kampsport, Fotboll, Friidrott, Beachvolleyboll

4
Motionsidrott

Tennis, Alpin skidåkning, Snowboard, Inomhusidrottsaktiviteter*

3
Motionsidrott

Jympa/Aerobics, Jogging, Styrketräning av benen, Ridning

2
Motionsidrott

Cykel, Mountainbike, Längdskidåkning, Skridsko, Golf, Dans, Inlines

1
Motionsidrott

Simning, Promenader, Stavgång

0
Ingen motions- eller tävlingsidrott

* Inomhusaktiviteter: exempelvis Squash, Badminton, Basketboll, Volleyboll
* Inomhusaktiviteter: exempelvis Squash, Badminton, Basketboll, Volleyboll

Vilket av följande alternativ stämmer i dagsläget bäst in på dig i förhållande till din tidigare huvudsakliga idrotts-/motionsaktivitet

☐ Jag deltar inte i någon idrotts- / motionsaktivitet

☐ Jag idrottar/motionerar men inte i min tidigare huvudsakliga idrotts-/motionsaktivitet

☐ Jag deltar i min tidigare huvudsakliga idrotts-/motionsaktivitet men på en lägre prestationsnivå än tidigare

☐ Jag deltar i min tidigare huvudsakliga idrotts-/motionsaktivitet på en motsvarande eller högre prestationsnivå

Hur lång tid tog det innan du återgick till idrott (full deltagande i träning och, om relevant, tävling) efter din höftartroskopi? Vänligen ange antal månader

Är du nöjd med din nuvarande idrotts-/motionsnivå?

☐ Ja

☐ Nej

Hip-RSI Scale

Instruktioner:

Vänligen svara på följande frågor med tanke på den huvudsakliga idrottsaktivitet du utövade innan skadan. Besvara varje fråga genom att dra markören till en punkt på linjen, som beskriver hur du upplever situationen just nu i relation till de två ytterligheterna.

OBS Markören behöver röras aktivt för att ett svar ska registreras, om du vill markera längst till vänster behöver du alltså ändå röra markören innan du placerar den där.

Är du säker på att du kan utöva din idrottsaktivitet på samma nivå som tidigare?

Tror du det är sannolikt att du skadar din höft igen genom att delta i din idrottsaktivitet?

Är du orolig för att utöva din idrottsaktivitet?

Är du säker på att din höft inte kommer att ge vika vid utövandet av din idrottsaktivitet?

Är du säker på att du kan utöva din idrottsaktivitet utan att bekymra dig för din höft?

Upplever du att det är frustrerande att behöva ta hänsyn till din höft med avseende på din idrottsaktivitet?

Är du rädd för att skada din höft igen vid utövandet av din idrottsaktivitet?

Är du säker på att din höft klarar att bibehålla kontroll under belastning?

Är du rädd att du, av en olyckshändelse, skadar din höft vid utövandet av din idrottsaktivitet?

Har tankar på att vara tvungen att genomgå operation och rehabilitering igen, hindrat dig från att utöva din idrottsaktivitet?

Är du säker på din förmåga att kunna prestera bra i din idrottsaktivitet?

Känner du dig avspänd inför att utöva din idrottsaktivitet?

Får vi koppla dina svar till journaldata avseende din diagnos och operation, samt uppföljningsmätningar avseende styrka och rörlighet (gäller endast om du besökt kliniken för sexmånadersuppföljning)? All presentation sker endast på gruppnivå

☐ Ja

☐ Nej

Appendix 3

Appendix 3

Study ID

HSAS (Hip Sports Activity Scale - Swedish)

Uppskatta din aktivitetsnivå vid olika tidpunkter enligt skalan nedan. Fyll i den siffra som stämmer bäst.

Uppskatta din nuvarande aktivitetsnivå (oavsett om du är opererad eller inte).

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8

Uppskatta din aktivitetsnivå som den var innan du fick symptom från höften.

- ☐ 0
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8

8
Tävlingsidrott (nationell och internationell elitnivå):

Fotboll, Ishockey, Innebandy, Kampsport, Tennis, Friidrott, Inomhusidrottsaktiviteter*, Beachvolleyboll

7
Tävlingsidrott (nationell och internationell elitnivå)

Alpin skidåkning, Snowboard, Konståkning, Skridsko, Dans

Tävlingsidrott (lägre divisioner)

Fotboll, Ishockey, Innebandy, Kampsport, Tennis, Friidrott, Inomhusidrottsaktiviteter*, Beachvolleyboll

6
Tävlingsidrott (nationell och internationell elitnivå)

Golf, Cykel, Mountainbike, Simning, Rodd, Längdskidåkning, Ridning

Tävlingsidrott (lägre divisioner)

Alpin skidåkning, Snowboard, Konståkning, Skridsko, Dans

5
Tävlingsidrott (lägre divisioner)

Golf, Cykel, Mountainbike, Simning, Rodd, Längdskidåkning, Ridning

Motionsidrott

Ishockey, Innebandy, Kampsport, Fotboll, Friidrott, Beachvolleyboll

4
Motionsidrott

Tennis, Alpin skidåkning, Snowboard, Inomhusidrottsaktiviteter*

3
Motionsidrott

Jympa/Aerobics, Jogging, Styrketräning av benen, Ridning

2
Motionsidrott

Cykel, Mountainbike, Längdskidåkning, Skridsko, Golf, Dans, Inlines

1
Motionsidrott

Simning, Promenader, Stavgång

0
Ingen motions- eller tävlingsidrott

* Inomhusaktiviteter: exempelvis Squash, Badminton, Basketboll, Volleyboll
* Inomhusaktiviteter: exempelvis Squash, Badminton, Basketboll, Volleyboll

Vilket av följande alternativ stämmer i dagsläget bäst in på dig i förhållande till din tidigare huvudsakliga idrotts-/motionsaktivitet

- ☐ Jag deltar inte i någon idrotts- / motionsaktivitet
- ☐ Jag idrottar/motionerar men inte i min tidigare huvudsakliga idrotts-/motionsaktivitet
- ☐ Jag deltar i min tidigare huvudsakliga idrotts-/motionsaktivitet men på en lägre prestationsnivå än tidigare
- ☐ Jag deltar i min tidigare huvudsakliga idrotts-/motionsaktivitet på en motsvarande eller högre prestationsnivå

Är du nöjd med din nuvarande idrotts-/motionsnivå?

- ☐ Ja
- ☐ Nej

HAGOS - Frågeformulär om höft- och/eller ljumskproblem

Detta frågeformulär innehåller frågor om hur din höft och/eller ljumske fungerar. Du skall ange hur din höft och/eller ljumske har fungerat **under den senaste vecka**n. Svaren skall hjälpa oss att kunna förstå hur du har det och hur bra du klarar dig i vardagen.

Du skall besvara frågorna genom att kryssa för det alternativ som passar dig bäst. Du skall endast ange ett kryss för varje fråga. Du skall svara på alla frågorna. Om en fråga inte gäller dig eller om du inte upplevt besväret under den senaste veckan, så ange det alternativ som passar bäst in och som du känner dig mest nöjd med.

Symptom

Tänk på de **symptom** och besvär du har haft i din höft och/eller ljumske under **den senaste**

veckan när du svarar på följande frågor.

S1 Har du malande/obehag i höften och/eller ljumsken?

- ☐ Aldrig
- ☐ Sällan
- ☐ Ibland
- ☐ Ofta
- ☐ Alltid

S2 Har du hört klickande eller andra ljud från höften och/eller ljumsken?

- ☐ Aldrig
- ☐ Sällan
- ☐ Ibland
- ☐ Ofta
- ☐ Hela tiden

S3 Har du problem med att få benen långt ut åt sidan?

- ☐ Inga
- ☐ Lite
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

S4 Har du problem med att ta steget fullt ut när du går?

- ☐ Inga
- ☐ Lite
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

S5 Får du plötsliga stickande/pirrande förnimmelser i höften och/eller ljumsken?

- ☐ Aldrig
- ☐ Sällan
- ☐ Ibland
- ☐ Ofta
- ☐ Hela tiden

Stelhet

Följande frågor handlar om **stelhet i höften och/eller ljumsken**. Stelhet medför besvär att komma igång eller ett ökat motstånd när du böjer höften och/eller ljumsken. **Ange i hur stor grad du har upplevt stelhet i höften och/eller ljumsken under den senaste veckan.**

S6 Hur stel är du i din höft och/eller ljumske när du just har vaknat på morgonen?

- ☐ Inte alls
- ☐ Lite
- ☐ Måttlig
- ☐ Mycket
- ☐ Extremt

S7 Hur stel är du i din höft och/eller ljumske senare på dagen, efter att du har suttit eller legat och vilat dig?

- ☐ Inte alls
- ☐ Lite
- ☐ Måttlig
- ☐ Mycket
- ☐ Extremt

Smärtor

P1 Hur ofta har du ont i höften och/eller ljumsken?

- ☐ Aldrig
- ☐ Varje månad
- ☐ Varje vecka
- ☐ Varje dag
- ☐ Alltid

P2 Hur ofta har du ont på andra ställen än i höften och/eller ljumsken som du tycker hänger ihop med dina höft- och/eller ljumskproblem?

- ☐ Aldrig
- ☐ Varje månad
- ☐ Varje vecka
- ☐ Varje dag
- ☐ Alltid

Följande frågor handlar om hur ofta du haft smärta i höften och/eller ljumsken **under den senaste veckan. Ange graden av höft- och/eller ljumsksmärta du har upplevt i följande situationer.**

P3 Sträcka ut höften helt och hållet

- ☐ Ingen
- ☐ Lätt
- ☐ Måttlig
- ☐ Svår
- ☐ Mycket svår

P4 Böja höften helt och hållet

- [ ] Ingen
- [ ] Lätt
- [ ] Måttlig
- [ ] Svår
- [ ] Mycket svår

P5 Gå upp- eller nedför trappor

- [ ] Ingen
- [ ] Lätt
- [ ] Måttlig
- [ ] Svår
- [ ] Mycket svår

P6 Om natten när du ligger ned (smärtor som förstör din sömn)

- [ ] Ingen
- [ ] Lätt
- [ ] Måttlig
- [ ] Svår
- [ ] Mycket svår

P7 Sitta eller ligga

- [ ] Ingen
- [ ] Lätt
- [ ] Måttlig
- [ ] Svår
- [ ] Mycket svår

Följande frågor handlar om hur ofta du har haft smärta i höften och/eller ljumsken **under**

den senaste veckan. Ange graden av höft- och/eller ljumsksmärta du har upplevt i följande situationer.

P8 Stående

- [ ] Ingen
- [ ] Lätt
- [ ] Måttlig
- [ ] Svår
- [ ] Mycket svårt

P9 Gå på hårt underlag, på asfalt eller sten

- ☐ Ingen
- ☐ Lätt
- ☐ Måttlig
- ☐ Svår
- ☐ Mycket svårt

P10 Gå på ojämnt underlag

- ☐ Ingen
- ☐ Lätt
- ☐ Måttlig
- ☐ Svår
- ☐ Mycket svårt

Fysisk funktion, dagliga aktiviteter

Följande frågor handlar om din fysiska funktion. **Ange graden av besvär du har haft i följande situationer under den senaste veckan, på grund av din höft och/eller ljumske.**

A1 Gå uppför trappor

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

A2 Böja dig ner, tex för att plocka upp något från golvet

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

A3 Kliva i/ur bil

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

A4 Ligga i sängen (vända dig eller hålla höften i samma läge under lång tid)

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

A5 Utföra tungt hushållsarbete (tvätta golv, dammsuga, bära drickabackar och liknande)

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

Funktion, sport och fritid

Följande frågor handlar om din fysiska förmåga. Du skall svara på ALLA frågor. Om en fråga inte gäller dig eller om du inte upplevt besväret under den senaste veckan, så ange det alternativ som passar bäst in och som du känner dig mest nöjd med. **Ange vilken grad av besvär du har haft i följande aktiviteter under den senaste veckan, på grund av problem med din höft och/eller ljumske.**

SP1 Sitta på huk

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

SP2 Springa

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

SP3 Vrida/snurra kroppen när du står på benet

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

SP4 Gå på ojämnt underlag

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

SP5 Springa så snabbt du kan

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

SP6 Föra benet framåt kraftigt och/eller till sidan, exempelvis som vid en spark, skridskosteg eller liknande

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

SP7 Plötsliga, explosiva rörelser som involverar snabba fotrörelser, exempelvis accelerationer, uppbromsningar, riktningsförändringar eller liknande

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

SP8 Situationer där benet rör sig helt ut i ytterläge (med ytterläge menas så långt ut från kroppen som möjligt)

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

Delta i fysisk aktivitet

Följande frågor handlar om din förmåga att delta i fysiska aktiviteter. Med fysiska aktiviteter menas idrottsaktiviteter, men även andra aktiviteter, där man blir lätt andfådd. Ange i vilken grad din förmåga att delta i önskade fysiska aktiviteter har varit påverkade under senaste veckan, på grund av dina problem med din höft och/eller ljumske.

PA1 Kan du delta i önskade fysiska aktiviteter så länge du vill?

- ☐ Alltid
- ☐ Ofta
- ☐ Ibland
- ☐ Sällan
- ☐ Aldrig

PA2 Kan du delta i önskade fysiska aktiviteter på din normala prestationsnivå?

- ☐ Alltid
- ☐ Ofta
- ☐ Ibland
- ☐ Sällan
- ☐ Aldrig

Livskvalitet

Q1 Hur ofta blir du påmind om dina problem med höften och/eller ljumsken?

- ☐ Aldrig
- ☐ Varje månad
- ☐ Varje vecka
- ☐ Varje dag
- ☐ Alltid

Q2 Har du ändrat ditt sätt att leva för att undgå att påfresta höften och/eller ljumsken?

- ☐ Inget alls
- ☐ Något
- ☐ Måttligt
- ☐ I stor utsträckning
- ☐ Totalt

Q3 Hur stora problem har du generellt med din höft och/eller ljumske?

- ☐ Inga
- ☐ Lätta
- ☐ Måttliga
- ☐ Stora
- ☐ Mycket stora

Q4 Påverkar dina problem med höften och/eller ljumsken ditt humör i en negativ riktning?

- ☐ Aldrig
- ☐ Sällan
- ☐ Ibland
- ☐ Ofta
- ☐ Alltig

Q5 Känner du dig begränsad p.g.a. problem med din höft och/eller ljumske?

- ☐ Aldrig
- ☐ Sällan
- ☐ Ibland
- ☐ Ofta
- ☐ Alltid

Tack för att du har besvarat Alla frågorna!

Appendix 4

Så här fyller du i pappersenkäten
Nedan ser du hur du markerar ett svarsalternativ, och hur du avmarkerar ett redan gjort val.

☒ Korrekt markerat svarsalternativ

☒ Inkorrekt markerat svarsalternativ, krysset ska vara mitt i rutan

☒ Inkorrekt markerat svarsalternativ, krysset är alltför kraftigt

☒ Ångrat val, svarsalternativet räknas inte som markerat

Är du...

☐ ...ortoped?

☐ ...fysioterapeut?

☐ ...patient?

För hur många år sedan träffade du din första höftatroskopipatient?

Hur många höftartroskopipatienter (ca) har du träffat sedan dess?

För hur många år sedan utförde du din första höftartroskopi?

Hur många höftartroskopier (ca) har du utfört sedan dess?

För hur många månader sedan gjordes din (senaste) höftartroskopi?

Har du gjort mer än en höftartroskopi?

☐ Ja

☐ Nej

Vänligen läs igenom följande 12 frågor och skatta deras relevans för återgång till idrott efter höftartroskopi

1. Är du säker på att du kan utöva din idrottsaktivitet på samma nivå som tidigare?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

2. Tror du det är sannolikt att du skadar din höft igen genom att delta i din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

3. Är du orolig för att utöva din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

4. Är du säker på att din höft inte kommer att ge vika vid utövandet av din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

5. Är du säker på att du kan utöva din idrottsaktivitet utan att bekymra dig för din höft?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

6. Upplever du att det är frustrerande att behöva ta hänsyn till din höft med avseende på din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

7. Är du rädd för att skada din höft igen vid utövandet av din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

8. Är du säker på att din höft klarar att bibehålla kontroll under belastning?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

9. Är du rädd att du, av en olyckshändelse, skadar din höft vid utövandet av din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

10. Har tankar på att vara tvungen att genomgå operation och rehabilitering igen, hindrat dig från att utöva din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

11. Är du säker på din förmåga att kunna prestera bra i din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

12. Känner du dig avspänd inför att utöva din idrottsaktivitet?

- ☐ Inte relevant
- ☐ Någorlunda relevant
- ☐ Ganska relevant
- ☐ Mycket relevant

Tycker du att enkäten saknar någon viktigt aspekt i relation till psykologisk beredskap för återgång till idrott efter höftartroskopi? Vänligen ange detta i så fall

Appendix 5a

Appendix 5a_Testingprotocol

TESTPROTOKOLL

1. ROM

Testet kommer att utföras på vänster respektive höger ben på samtliga försökspersoner. Samtliga rörelsemätningar kommer att utföras i ryggliggandes och mätningen kommer att utföras en gång per rörelse och ben. I samband med rörelsemätningen kommer även en benlängdsmätning att göras, för att kunna normalisera resultaten i det prestationsbaserade testet, The Y-balance test.

Mätningen kommer att utföras enligt följande ordning;

- Markering av anatomiska utgångspunkter Mätinstrument: Måttband
- Benlängdsmätning Mätinstrument: Måttband
- VÄ Höftflexion Mätinstrument: Goniometer
    - Aktiv flexion
    - Passiv flexion
- HÖ höftflexion Mätinstrument: Goniometer
    - Aktiv flexion
    - Passiv flexion
- VÄ inåtrotation Mätinstrument: Inclinometer
- VÄ utåtrotation Mätinstrument: Inclinometer
- HÖ inåtrotation Mätinstrument: Inclinometer
- HÖ utåtrotation Mätinstrument: Inclinometer

Instruktioner
Forskningspersonen instrueras till att vara avslappnad och låta testledaren utföra rörlighetsmätningen utan forskningspersonens inverkan, med undantag för aktiv höftflexion.

Flexion:
Aktiv flexion: Ryggliggande med kontralateralt ben liggandes rakt på britsen. Forskningspersonen instrueras att aktivt böja höften så mycket som möjligt på det ipsilaterala benet. Mätningen görs mellan britsen (horisontel linje) och den tänkta linjen mellan trochanter major och laterala femur epicondylen.

Passiv flexion: Ryggliggande med kontralateralt ben liggandes rakt på britsen. Forskningspersonen omfattar sitt knä på det ipsilaterala benet och drar det mot axeln tills att ett stopp noteras utan kompensation från bäckenet. Mätningen görs mellan britsen (horisontel linje) och den tänkta linjen mellan trochanter major och laterala femur epicondylen.

Inåtrotation: Liggandes på rygg, höften i en neutral position, 90gr höftflexion och 90gr knäflexion. Rotationen tas ut tills att SIAS börjar att röra sig. Inclinometern placeras över tuberositas tibiae.

Utåtrotation: Liggandes på rygg, höften i en neutral position, 90gr höftflexion och 90gr knäflexion. Rotationen tas ut tills att SIAS börjar att röra sig. Inclinometern placeras över tuberositas tibiae.

Benlängdsmätning: Ryggliggande. Anatomiska utgångspunkter Antero Superior Iliac Spine till mitten utav ipsilaterla mediala malleolen.

2. Styrka

Innan testet påbörjas kommer en lottning att genomföras gällande i vilken ordning man utför mätningarna. Först lottas startben, det vill säga höger eller vänster ben. Därefter lottas startpositionen, mag- eller ryggliggande. Om forskningspersonen ska utföra första mätningen liggandes på exempelvis rygg, kommer en lottning göras avseende startordning för abduktion- och adduktionssrörelsen. Flexionsrörelsen utförs alltid sist i ryggliggande. Därefter kommer en lottning att göras gällande testerna i magliggande, avseende startordning för inåtrotation- och utåtrotationsrörelsen. Extensionsrörelsen utförs alltid sist i magliggande. Mätningarna kommer att utföras i samma ordning på höger respektive vänster ben, oavsett vilket ben som startar.

Instruktioner
Forskningspersonen instrueras att, när testledaren säger "börja pressa", successivt öka trycket tills att en maximal kraft mot dynamometern har uppnåtts. Trycket ska bibehållas under 5 sekunder. Innan respektive testriktning startar ska forskningspersonen utföra en submaximal kontraktion mot dynamometern för att försäkra att kraften går åt önskat håll.

Standardiserat kommando för samtliga test:
"Börja pressa, tryck, tryck, tryck och slappna av" .

Testen upprepas 3 gånger åt varje håll. Sker en ökning i sista testet med över 10% repeteras testet en gång till. Mellan varje försök råder 30 sekunder vila. Samtliga värden registreras. Efter varje testförsök tillfrågas patienten huruvida hen kände någon smärta under försöket, som ska besvaras med "Ja" eller "Nej".

Abduktion: Liggandes på rygg med 1⁄2 underbenet utanför britsen, höft i neutralposition, rakt knä. HHD placerad 5cm ovan laterala malleolens mest prominenta del. Foten på det kontralaterala benet placeras i britsen i höjd med knät på testbenet. Patienten håller i britskanten och instrueras att hålla ett rakt knä på testbenet under testet.

Adduktion: Liggandes på rygg med 1⁄2 underbenet utanför britsen, höft i neutralposition, rakt knä. HHD placerad 5cm ovan mediala malleolens mest prominenta del. Foten på det kontralaterala benet placeras i britsen i höjd med knät på testbenet. Patienten håller i britskanten och instrueras att hålla ett rakt knä på testbenet under testet.

Flexion: Liggandes på rygg med höften i 90 graders flexion, 90 grader knäflexion (utmätt med goniometer). HHD placerad 5cm ovan patellas proximala kant. Kontralateralt ben är rakt. Patienten håller i britskanten.

Extension: Liggandes på mage med fötterna utanför britsen, höft i neutralposition, rakt knä. HHD placerad 5cm ovan mediala malleolens mest prominenta del dorsalt över vadmuskeln. Patienten håller i britskanten och instrueras att hålla ett rakt knä på testbenet under testet.

Inåtrotation:
Liggandes på mage, höft i neutralposition och 90grader knäflexion. HHD placerad 5cm ovan laterala malleolen mest prominenta del. Kontralateralt ben är rakt. Fixera knä och ilium på det ipsilaterala benet. Patienten håller i britskanten med båda händerna.

Utåtrotation:
Liggandes på mage, höft i neutralposition och 90grader knäflexion. HHD placerad 5cm ovan mediala malleolen mest prominenta del. Ipsilaterala benet är rakt. Fixera ilium på det kontralaterala benet. Patienten håller i britskanten med båda händerna.

3. PBMs

Testerna kommer att utföras enligt följande ordning för både patientgruppen och jämförelsegruppen;

a. The Y-Balance test
b. Medial and lateral triple hop test
c. Ilinois Agility Run test

Randomiseringsordningen finns på pappret i den röda mappen. Randomisering avser startben för test a-c. Avseende test d, gäller följande:
Patientgrupp. Startar på samma sida som de har gjort sin operation (senaste gäller om de har opererat båda). Således, op hö höft, start magliggandes på hö sida.

Efter respektive test/testomgång kommer forskningspersonen tillfrågas huruvida hen kände någon smärta under testet, som ska besvaras med "Ja" eller "Nej". Om forskningspersonen besvarar frågan med "Ja" ska smärtan graderas med hjälp utav en numerisk smärtskala där graderingen noll på skalan står för ingen smärta och tio står för den absolut värst tänkbara smärtan. Den högsta smärtan under testet ska noteras.
Notera även kroppsdel.

I samband med instruktionerna har jag också visat varje test, hur de ska göra.

Information till forskningspersonerna innan testerna påbörjas:

Samtliga tester är utformade så att du kan utföra dem utefter din fysiska förmåga. Jag (testledaren) kommer att informera dig inför respektive test vad som gäller samt ge möjlighet till uppvärmning utav respektive test innan det faktiska testet påbörjas.

3.1. The Y-Balance test

Montering av Y-balance test
- Det står en siffra på resp pinne och hål på mitten klossen. Placera resp pinne i resp hål och sätt fast dem med en skruv. (skruvarna ligger påsen som tobi har).
- Dra sedan på klossarna på resp pinne. Står även en siffra på resp kloss, på undersidan. Den röda tejpen ska vara riktad in mot mitten och siffran på klossen ska peka ner mot golvet.
- Placera en antiglid under mittenklossen.

Testet kommer att utföras barfota. Testet utförs i tre olika riktningar i förhållande till det stående benet, framåt (Anterior), diagonalt bakåt och på medialsidan om det utsträckta benet (Postero-medial) och diagonalt bakåt och på lateralsidan om det utsträcka benet (Postero-lateral). Längden på forskningspersonen utsträckta ben mäts genom att läsa av hur långt forskningspersonen har klarat av att trycka/fösa den rörliga träklossen, avläsningen görs på den sida om klossen som är närmast forskningspersonen. Avläsning görs på 0,5cm nivå. Sker en ökning i sista testet med över 10% repeteras testet ytterligare gånger.

Instruktioner:

- Detta test går ut på att du ska stå på ett ben, med foten precis bakom linjen som är ritad på träklossen i mitten utav Y:et. Du ska sedan med hjälp utav det andra benet trycka/fösa träklossen så långt som möjligt och därefter återgår du med det utsträckta benet till startpositionen. Du får endast trycka med tårna på den rödfärgade delen på träklossen (långsidan) annars räknas inte försöket.
- Detta ska genomföras åt samtliga tre riktningar, med start framåt. Du ska genomföra testet både på höger och vänster ben innan du påbörjar nästa riktning. Du ska genomföra tre godkända försök per riktning och ben innan testet är slutfört.

- Du kommer nu att få möjlighet till uppvärmningsförsök, åt samtliga riktningar, tills att du känner dig redo att påbörja testet. Tänk dock på att inte trötta ut dig innan testet påbörjas.
- Information som ges under uppvärmning: Om du inte klarar av att hålla balansen på ett ben; det vill säga att du lyfter eller flyttar den stående foten, nuddar golvet med den utsträckta foten eller inte klarar att återgå till utgångspositionen med det utsträckta benet godkänns försöket inte och du får ett nytt försök. Det är inte heller tillåtet att nudda med händerna i golvet. Du får inte heller ”skjutsa” iväg klossen sista biten, måste ha kontakt med klossen.

3.2 Medial and lateral triple hop test

Personen startar med foten bakom den blåa linjen och tejpen (markering för avståndet) sätts på den delen av foten som är närmast startpositionen.

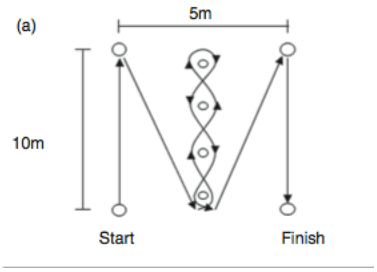
Forskningspersonen utför tre hopp i varje riktning per ben och samtliga tre hopp i en riktning ska utföras innan nästa riktning påbörjas. Ex Om startben hö, börja med medial riktning och därefter lateral riktning innan vä ben. Pat hoppar samtliga tre hopp på hö ben och medial riktning, mät sedan samtliga tre hopp. Sker en ökning i sista testet med över 10% repeteras testet ytterligare gånger. Avståndet mäts i centimeter.

Instruktioner:

- I detta test ska du starta, stående på ett ben med foten vinkelrätt till måttbandet på golvet. Du ska sedan hoppa tre hopp, på ett och samma ben, direkt efter varandra. Du får med andra ord inte stanna mellan hoppen, utan du ska skjuta ifrån till nästa hopp direkt.
- Efter det tredje och sista hoppet ska du landa på samma ben som du startade med och försöka landa kontrollerat. Du ska i landningen stå kvar minst ca fem sekunder för att hoppet ska vara godkänt. Om du hoppar i landningen, sätter i den andra foten eller händerna godkänns hoppet inte och får du ytterligare försök.
- Forskningspersonen provar enligt ovanstående instruktioner med uppmaning om att börja hoppa lugnt och kort för att säkerställa en kontrollerad/balanserad landning. Dubbelkolla även ev anamnes med fotledsstukningar, för att i så fall vara ännu mer försiktig till en början. Vill undvika fler fotledsstukningar!
- Under uppvärmningen ges nedanstående information. På varje ben ska du hoppa i två olika riktningar. Det vill säga att du ska hoppa stående på höger ben både till höger och vänster och likaså stående på vänster ben.
- Du ska utföra tre godkända försök åt varje riktning på respektive ben. Se till att varje person får lite vila mellan varje försök och sen en längre vila mellan varje omgång. Blir det automatiskt i och med att du ska mäta resultaten. (Du får upp till 30sekunders vila mellan varje försök och upp till tre minuters vila mellan de olika riktningarna). Målet är att du ska hoppa så långt som möjligt.
- Tänk på att uppvärmningen endast är till för att prova dem olika hoppen, du ska inte bli uttröttad.

3.3 Illinois Agility Run test (IAR)

Fyra koner placeras så att de markerar en yta på 10 meter (längd) gånger 5 meter (bredd). I mitten utav ytan placeras 4 koner med 3,3meters mellanrum. Se figur nedan.



Innan testet påbörjas verifieras vilken nuvarande fysisk aktivitetsnivå forskningspersonen har, baserat på vad forskningspersonen har fyllt i bakgrundsinformationen. För att få genomföra detta test ska forskningspersonen gradera minst en tvåa på HSAS. Om forskningspersonen har graderat en etta på HSAS, kompletteras det med en fråga efter att han/hon mottagit information gällande testet;

”Känner du dig bekväm med att genomföra detta test utefter instruktionerna?”
Om Ja, forskningspersonen får genomföra testet.
Om Nej, forskningspersonen får inte genomföra testet.

För patientgruppen startar dem på samma sida som den sida de har opererat, således;
Operation höger höft -> Startar höger sida och avslutar på vänster sida.
Operation vänster höft -> Startar på vänster sida och avslutar på höger sida.

För jämförelsegruppen, startar varannan person med start från höger sida och varannan från vänster sida. Lottning görs för att bestämma vilken sida den första personen ska starta med. Se aktuell randomisering.

I samband med instruktionerna, spring igenom hela rundan och visa forskningspersonen hur han/hon ska göra. Därefter ska de jogga igenom själva en gång för att lära sig banan, innan start av test.

Instruktioner:

- Du kommer att starta liggandes på golvet, med magen neråt och huvudet placerat precis bakom startlinjen. Händerna ska vara i linje med axlarna.

- Vid startinstruktionen, ”Kör”, ska du ta dig upp från golvet och springa upp och nudda den första konen/markeringen, tillbaka ner till den första utav fyra koner som är placerade i mitten utav ytan. Du ska sedan springa slalom mellan konerna i mitten, fram och tillbaka. Spring sedan upp och nudda den sista konen innan du spurtar in i mål. Om start hö sida ska forskningspersonen nudda med hö hand.

- Du kommer att få tre försök på dig och du kommer att få tre minuters vila mellan varje försök. Målet är att springa igenom banan så fort som möjligt.

- ANVÄND VATTEN UNDER SKORNA så de inte trillar samt vågar ta i.

Appendix 5b

Appendix 5b_Scoring sheet

KODNUMMER:

RESULTATPROTOKOLL

Testdatum:

Patientgrupp / Jämförelsegrupp *(ringa in vilken grupp forskningspersonen tillhör)*

Påskriven och inlämnad samtyckesblankett: ☐

Mätningar *(fylls i utav testledare)*

Längd:_____

Vikt:_____

Enkäter *(fylls i utav testledare)*

HSAS: ☐

HAGOS: ☐

KODNUMMER:

1. BAKGRUNDSINFORMATION OCH ENKÄTER

Bakgrundsinformation *(fylls i utav forskningsperson)*

1. Kön: Man / Kvinna

2. Ålder:_____

3. Yrke: _____

4. Träningsform/idrott: _____

5. Hur många timmar tränar du i veckan?_____

6. Dominant ben: Höger / Vänster
(baserat på det ben du väljer att sparka en boll med)

7. Har du någon gång genomgått en/flera operationer i höft, knä och/eller fot? Ja/Nej
Om Ja;
När? _____
Vilken typ av operation?_____
Vilken kroppsdel samt höger eller vänster sida? _____
_____

8. Har du, under de senaste sex månaderna, behandlats för besvär från rygg, höft, knä och/eller fot? *(Detta avser besvär utöver din eventuella höftoperation)*
Om Ja, Beskriv kortfattat besvär och aktuell behandling.
_____
_____
_____
_____

KODNUMMER:

2. RÖRELSEMÄTNING MED GONIOMETER OCH INLCINOMETER

Benlängdsmätning:

Vänster: _____cm

Höger: _____cm

Flexion:

Aktiv flexion:

Test 1: VÄ:	grader	Smärta: JA / NEJ
Test 1: HÖ:	grader	Smärta: JA / NEJ

Passiv flexion:

Test 1: VÄ:	grader	Smärta: JA / NEJ
Test 1: HÖ:	grader	Smärta: JA / NEJ

Inåtrotation:

Test 1: VÄ:	grader	Smärta: JA / NEJ
Test 1: HÖ:	grader	Smärta: JA / NEJ

Utåtrotation:

Test 1: VÄ:	grader	Smärta: JA / NEJ
Test 1: HÖ:	grader	Smärta: JA / NEJ

KODNUMMER:

3. HÖFTSTYRKA MED HANDHÅLLEN DYNAMOMETER (HHD)

Testordning *(lottas innan testerna startar, enligt beskrivning i testprotokollet).*

1._____ 4._____

2._____ 5._____

3._____ 6. _____

Abduktion

Test 1: HÖ: Smärta: JA / NEJ
Test 2: HÖ: Smärta: JA / NEJ
Test 3: HÖ: Smärta: JA / NEJ

Test 1: VÄ: Smärta: JA / NEJ
Test 2: VÄ: Smärta: JA / NEJ
Test 3: VÄ: Smärta: JA / NEJ

Adduktion

Test 1: HÖ: Smärta: JA / NEJ
Test 2: HÖ: Smärta: JA / NEJ
Test 3: HÖ: Smärta: JA / NEJ

Test 1: VÄ: Smärta: JA / NEJ
Test 2: VÄ: Smärta: JA / NEJ
Test 3: VÄ: Smärta: JA / NEJ

Flexion

Test 1: HÖ: Smärta: JA / NEJ
Test 2: HÖ: Smärta: JA / NEJ
Test 3: HÖ: Smärta: JA / NEJ

Test 1: VÄ: Smärta: JA / NEJ
Test 2: VÄ: Smärta: JA / NEJ
Test 3: VÄ: Smärta: JA / NEJ

KODNUMMER:

Inåtrotation

Test 1: HÖ: Smärta: JA / NEJ
Test 2: HÖ: Smärta: JA / NEJ
Test 3: HÖ: Smärta: JA / NEJ

Test 1: VÄ: Smärta: JA / NEJ
Test 2: VÄ: Smärta: JA / NEJ
Test 3: VÄ: Smärta: JA / NEJ

Utåtrotation

Test 1: HÖ: Smärta: JA / NEJ
Test 2: HÖ: Smärta: JA / NEJ
Test 3: HÖ: Smärta: JA / NEJ

Test 1: VÄ: Smärta: JA / NEJ
Test 2: VÄ: Smärta: JA / NEJ
Test 3: VÄ: Smärta: JA / NEJ

Extension

Test 1: HÖ: Smärta: JA / NEJ
Test 2: HÖ: Smärta: JA / NEJ
Test 3: HÖ: Smärta: JA / NEJ

Test 1: VÄ: Smärta: JA / NEJ
Test 2: VÄ: Smärta: JA / NEJ
Test 3: VÄ: Smärta: JA / NEJ

KODNUMMER:

4. PRESTATIONSBASERADE TESTER (PBM)

Startben; gäller på testerna 4a, 4b, 4c *(lottas innan testerna startas)*: Höger / Vänster

4a. Single Leg Squat

Höger ben
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Vänster ben
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Trygghet
På en skala från 0-10, där noll står för ”inte trygg alls” och tio står för ”mycket trygg”, hur trygg kände du dig när du utförde detta test?

Gradering enligt numerisk skala: 0 1 2 3 4 5 6 7 8 9 10

SLS instruktioner JA / NEJ

KODNUMMER:

4b. The Y-Balance test

Anterior

Test 1: HÖ: cm
Test 2: HÖ: cm
Test 3: HÖ: cm
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Test 1: VÄ: cm
Test 2: VÄ: cm
Test 3: VÄ: cm
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Postero-medial

Test 1: HÖ: cm
Test 2: HÖ: cm
Test 3: HÖ: cm
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Test 1: VÄ: cm
Test 2: VÄ: cm
Test 3: VÄ: cm
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Postero-lateral

Test 1: HÖ: cm
Test 2: HÖ: cm
Test 3: HÖ: cm
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Test 1: VÄ: cm
Test 2: VÄ: cm
Test 3: VÄ: cm
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Trygghet

På en skala från 0-10, där noll står för ”inte trygg alls” och tio står för ”mycket trygg”, hur trygg kände du dig när du utförde detta test?

Gradering enligt numerisk skala: 0 1 2 3 4 5 6 7 8 9 10

Vid EJ utfört test, ange anledning om möjligt…….

KODNUMMER:

4c. Medial and lateral triple hop test

Höger – Medial
Test 1: cm
Test 2: cm
Test 3: cm

Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Höger – Lateral
Test 1: cm
Test 2: cm
Test 3: cm

Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Vänster – Medial
Test 1: cm
Test 2: cm
Test 3: cm

Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Vänster – Lateral
Test 1: cm
Test 2: cm
Test 3: cm

Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Trygghet
På en skala från 0-10, där noll står för ”inte trygg alls” och tio står för ”mycket trygg”, hur trygg kände du dig när du utförde detta test?

Gradering enligt numerisk skala: 0 1 2 3 4 5 6 7 8 9 10

Vid EJ utfört test, ange anledning om möjligt…….

KODNUMMER:

4d. Ilinois Agility Run test (IAR)

Startsida: Höger/Vänster

Test 1: Sekunder

Test 2: Sekunder

Test 3: Sekunder

Medelvärde:

Smärta
Smärta: JA / NEJ
Om JA, Gradering enligt numerisk smärtskala: 0 1 2 3 4 5 6 7 8 9 10

Trygghet
På en skala från 0-10, där noll står för ”inte trygg alls” och tio står för ”mycket trygg”, hur trygg kände du dig när du utförde detta test?

Gradering enligt numerisk skala: 0 1 2 3 4 5 6 7 8 9 10

Vid EJ utfört test, ange anledning om möjligt…….

Paper I

Knee Surg Sports Traumatol Arthrosc (2018) 26:2519–2526
https://doi.org/10.1007/s00167-017-4676-6

HIP

Similar views on rehabilitation following hip arthroscopy among physiotherapists and surgeons in Scandinavia: a specialized care survey

T. Wörner[1] · K. Thorborg[2] · H. Moksnes[3,4] · F. Eek[1]

Received: 6 April 2017 / Accepted: 1 August 2017 / Published online: 14 August 2017

Abstract
Purpose The rising number of hip arthroscopies (HA) is leading to increasing numbers of patients requiring post-surgical rehabilitation; however, evidence regarding post-operative rehabilitation is currently limited. The purpose of the study was to describe and compare current rehabilitation strategies and views among surgeons and physiotherapists in Scandinavia.
Methods Scandinavian surgeons and physiotherapists experienced with HA and post-surgical rehabilitation were asked to complete an online survey. Ninety clinicians (28 surgeons, 62 physiotherapists) responded.
Results Both professions mostly rated physiotherapy as very or extremely important in the rehabilitation process. The majority advocated criteria-based or combined criteria- and time-based progression. Expected rehabilitation timelines were reported with large intra-professional variation but general inter-professional agreement. However, compared with physiotherapists surgeons expected fewer weeks on crutches and faster return to competitive sport. Surgeons more often reported use of evidence-based self-reported outcomes while physiotherapists more often evaluated readiness for return to play.
Conclusions Among surgeons and physiotherapists, physiotherapy is considered very important following HA. Generally, very similar views were held between professions. Surgeons expected reduced time on crutches and to return to competitive sports than physiotherapists. Surgeons also used evidence-based self-reported outcomes to a higher degree than physiotherapists. Being the first study to provide an overview on currently applied rehabilitation strategies following HA, results of this study may guide much needed, future research on the rehabilitation process following HA.
Level of evidence IV.

Keywords Hip joint · FAI · Arthroscopy · Rehabilitation · Physiotherapy

Introduction

Hip arthroscopy (HA) is used to treat a variety of intra- and extra-articular pathologies [3]. The worldwide number of HAs being performed is increasing [7, 9, 25, 34], with a continued rise in numbers expected [21]. Alongside this rise, increasing numbers of patients are requiring post-surgical rehabilitation.

Current Scandinavian research on HA consists of a limited number of studies evaluating outcomes following surgery [11, 23, 28, 31, 32], but there have been efforts to initiate national HA registries [26, 30]. From an international perspective, there is a paucity of information regarding post-operative rehabilitation despite it being an integral part of the outcome [8, 18]. Only one Scandinavian study, investigating post-surgical outcomes, has reported details regarding post-surgical rehabilitation [12]. Systematic reviews

✉ T. Wörner
tobias.worner@med.lu.se

[1] Department of Health Sciences, Lund University, Box 157, 22100 Lund, Sweden

[2] Sports Orthopaedic Research Center (SORC-C), Department of Orthopaedic Surgery, Copenhagen University Hospital, Amager-Hvidovre, Copenhagen, Denmark

[3] Oslo Sports Trauma Research Center, Norwegian School of Sports Sciences, Oslo, Norway

[4] The Olympic Elite Sports Program (Olympiatoppen), Oslo, Norway

investigating rehabilitation following HA report that the majority of publications are clinical commentaries describing a variety of poorly reported rehabilitation protocols and express the need for further research within this field [8, 18].

Current evidence on rehabilitation following HA is limited to individual expert opinion and experience-based protocols. There is a need to bridge the gap between clinical practice and available evidence and for universal consensus regarding rehabilitation guidelines [8]. The extent to which orthopaedic surgeons performing HA advocate physiotherapist-led rehabilitation, as recommended at the Warwick hip arthroscopy multidisciplinary agreement meeting [17], is currently unknown. Furthermore, insight regarding opinions on post-surgical restrictions and expected timelines for rehabilitation between surgeons and physiotherapists is currently lacking. To address this gap in current knowledge, it is necessary to describe rehabilitation practices following HA. Evaluation of clinicians' perspectives regarding the rehabilitation process may show where clinicians have similar or opposing views. Observed differences may identify potential targets for future studies investigating specifics of the rehabilitation process.

The aim of this study is to provide an overview of the rehabilitation process following HA in Scandinavia. Current practice and perspectives regarding rehabilitation strategies among surgeons and physiotherapists providing specialized care within this field will be described. Furthermore, potential differences in perspectives on the rehabilitation process between professions will be explored.

Materials and methods

Scandinavian (Denmark, Norway, and Sweden) surgeons and physiotherapists experienced with HA and post-surgical rehabilitation were invited to participate in a web-based survey. A combination of convenience and snowball sampling was applied. Orthopaedic surgeons were primarily identified through participant lists of Scandinavian HA meetings. The list was complemented by crosschecking participant lists from the national Scandinavian HA meetings. Finally, surgical departments of clinics and hospitals involved in the Scandinavian ACL-registries were contacted. Physiotherapists were primarily invited through national sports medicine organizations via e-mail and social media. As a second step, physiotherapists were identified through referral patterns, reported by surgeons, as well as through clinics and hospitals involved in the ACL-registries with rehabilitation departments. Potential participants received an initial e-mail invitation to participate in the study during May and June 2016. Two reminders were sent 1 and 3 weeks after initial invitation. A total of 90 clinicians (62 physiotherapists, 28 orthopaedic surgeons) responded to the survey. Subject characteristics are summarized in Table 1.

Table 1 Subject characteristics

	Physiotherapists ($n = 62$)	Surgeons ($n = 28$)
Country [% (n)]		
Denmark	37.1 (23)	42.9 (12)
Norway	6.5 (4)	21.4 (6)
Sweden	56.5 (35)	35.7 (10)
Gender [% (n)]		
Females	40.3 (25)	–
Males	59.7 (37)	100 (28)
Working sector [% (n)]		
Private sector	58.1 (36)	32.1 (9)
Public sector	25.8 (16)	46.4 (13)
Public and private sector	16.1 (10)	21.4 (6)
Primary care providers [% (n)]	49.2 (30)	3.7 (1)
Specialists [% (n)]	50.8 (31)	96.3 (26)
Working at clinic providing both, surgery and rehabilitation [% (n)]	38.7 (24)	71.4 (20)
Experience with treatment of HA patients in years		
Mean (SD)	5.6 (3.42)	8.4 (6.05)
Median (IQR)	5 (3–8)	6.5 (4–11.75)
HA patients per year		
Mean (SD)	14.5 (22.41)	67.0 (55.03)
Median (IQR)	5 (3–15)	40 (30–108.75)

n number of respondents, *HA* hip arthroscopy, *SD* standard deviation, *IQR* interquartile range

Survey

A web-based survey was developed through a multiple step procedure. The final survey contained 27 questions regarding perceived value of physiotherapy (including different treatment modalities), progression criteria, outcome evaluation strategies, and expected time frames (minimum, maximum, and average expected number of weeks until different rehabilitation endpoints/outcomes). Respondents were asked to complete surveys with regard to a typical HA patient (defined as 25–40 years old with femoroacetabular impingement and chondral/labral injury).

Framework for survey content

Due to the absence of national guidelines and evidence-based rehabilitation protocols, the content of the survey was based on best available evidence [8, 18]. With respect to identified gaps in knowledge regarding the rehabilitation process following HA, the survey focused on the following content: (a) timeline of rehabilitation, (b) recommended/applied rehabilitation guidelines including progression

criteria (time-based/outcome-based), (c) utilization and choice of clinical outcome measures and (d) specifics of treatment such as treatment frequency and treatment modalities.

Question generation

The research group developed questions aiming to cover all contents described above through collaborative discussion. Question and answer options were formulated in English.

Face and content validity

The survey was evaluated for face and content validity through discussion with an expert group of clinicians having substantial experience in the performance of arthroscopy and subsequent rehabilitation (one surgeon, two physiotherapists). Results of the expert group meeting were summarized and discussed among the research group before implementation in the survey.

Translation

An officially certified translator translated the English version of the survey into Swedish, Danish and Norwegian languages. The Danish, Norwegian and Swedish members of the study group compared translations to originals. Discrepancies between translations and originals were discussed in the group and resolved by consensus.

Ethics

Participation in the survey was optional, and participants provided informed consent by responding to the survey. As the study did not handle any personal information or sensitive data, include any physical engagement, or in other ways affect the participants, no formal ethical approval was required.

Statistical analysis

All data were analysed using SPSS Statistics 23 (IBM Software). Descriptive statistics in the form of percentages or mean and standard deviation (for normally distributed numeric data) and/or median and interquartile range (for non-normally distributed numeric- or ordinal-scale data) were applied. Differences between professions were analysed using Chi-square tests for categorical variables and Mann–Whitney *U* tests for numeric data. For group comparisons, five category ordinal scales regarding perceived influence, importance, etc. were dichotomized by collapsing the two highest alternatives (e.g.: extremely/very; always/often) and the three lowest alternatives (e.g.: not at all/never; slightly/sometimes) and subsequently analysed by Chi-square test.

Due to the descriptive nature of the study, no sample size calculation was performed prior to data collection. It was aimed to include as many clinicians as possible from the limited number of individuals comprising the target population.

Results

Estimated timeline perspectives regarding rehabilitation milestones, by both surgeons and physiotherapists, are illustrated in Fig. 1. Large within-group variations were observed for timeline perspectives regarding expected milestones. Generally, both professions presented similar views regarding the estimated timeline of rehabilitation. Responses regarding the recommended time on crutches and the expected minimal time to return to competitive sport, however, differed significantly, with surgeons expecting fewer weeks compared with physiotherapists (Table 2). Surgeons more often reported using patient-reported outcomes (PROs) compared with physiotherapists, while physiotherapists more often reported evaluating readiness to return to sport and usage of performance-based measures (PBMs) in the rehabilitation process (Fig. 2 and Table 3).

Recommendations of post-surgical range of motion (ROM) restrictions are summarized in Fig. 3. Participants' ratings of influence of clinical outcomes on the return to sport (RTS) decision are illustrated in Fig. 4. Physiotherapists more often than surgeon-rated strength (physiotherapists: 88.9%, surgeons: 46.3%; $p = 0.003$) and performance-based measures (physiotherapists: 84.8%, surgeons: 46.2%; $p = 0.008$) to be influential in the RTS decision.

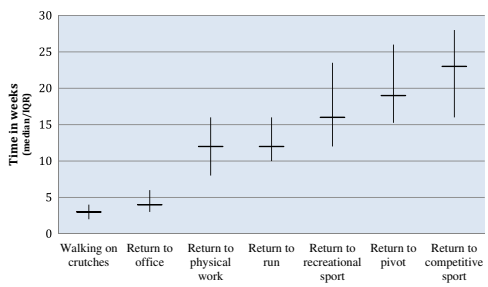


Fig. 1 Expected timeline of rehabilitation (professions combined)

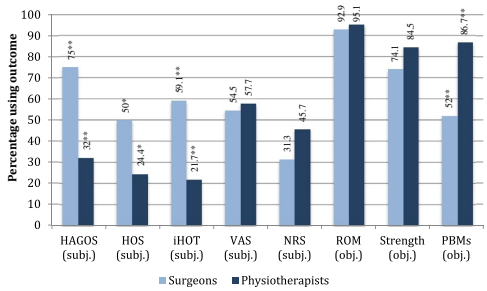


Fig. 2 Frequency (%) of used objective and subjective outcomes. *HAGOS* Copenhagen Hip and Groin Outcome Score, *HOS* Hip Outcome Score, *iHOT* International Hip Outcome Tool, *VAS* Visual Analogue Scale, *NRS* Numeric Rating Scale, *ROM* range of motion, *PBMs* performance-based measures, *subj.* subjective, *obj.* objective. *Between group comparison p value ≤0.05; **p value ≤0.01

Discussion

This is the first study to investigate current clinical practice in rehabilitation following HA, as implemented by surgeons and physiotherapists. Previous studies have only included post-surgical management from surgeons' perspectives [14, 19].

Physiotherapy was rated to be very important in rehabilitation following HA by both professions. These results are in line with the Warwick agreement recommending physiotherapist-led rehabilitation as the cornerstone of rehabilitation [17]. In general, both professions presented similar views on the rehabilitation process. More than 75% of respondents recommend either criteria-based or combined criteria- and time-based rehabilitation progression. Published rehabilitation protocols typically describe rehabilitation progression based on functional criteria and

Table 2 Expected timeline of rehabilitation by profession

	Physiotherapists (n = 62)			Surgeons (n = 28)			Professions combined (n = 90)
	AV	Min	Max	AV	Min	Max	AV
Recommended time on crutches in weeks (n)	49	60	56	26	26	23	75
Mean (SD)	3.4 (1.45)*	2.3 (1.40)	5.8 (2.68)*	2.6 (1.16)*	1.8 (1.13)	4.5 (2.45)*	3.1 (1.40)
Median (IQR)	4 (2–4)*	2 (1–3)	6 (4–7.5)*	2 (2–3)*	2 (1–2)	4 (3–6)*	3 (2–4)
Return to work in weeks							
Non-physical demanding job (n)	44	57	53	25	27	26	69
Mean (SD)	5.4 (3.98)	3.8 (2.78)	9.4 (7.84)	4.7 (2.69)	2.8 (2.13)	8.5 (5.97)	5.1 (3.56)
Median (IQR)	4 (3–7.75)	3 (2–6)	6 (4.5–12)	4 (2.5–6)	2 (1–4)	7 (5.5–12)	4 (3–6)
Physical demanding job (n)	43	55	50	25	27	26	68
Mean (SD)	13.0 (5.79)	9.4 (4.08)	19.2 (9.37)	12.6 (4.98)	9.2 (3.97)	19.7 (11.02)	12.8 (5.47)
Median (IQR)	12 (8–16)	8 (6–12)	16 (12–21)	12 (8–15)	8 (6–12)	16 (12–24.5)	12 (8–16)
Recommended time no running in weeks (n)	45	58	51	22	25	22	67
Mean (SD)	14.0 (6.18)	10.5 (3.5)	20.8 (11.31)	13.6 (5.91)	9.5 (2.66)	20.6 (11.49)	13.9 (6.05)
Median (IQR)	12 (10–16)	12 (8–12)	16 (12–24)	12 (9.75–16)	10 (8–12)	18 (12–24.5)	12 (10–16)
Recommended time no cut/pivot in weeks (n)	43	57	50	21	24	21	64
Mean (SD)	20.8 (9.00)	15.6 (6.04)	30.2 (14.99)	20.0 (7.42)	14.3 (7.18)	30.2 (14.79)	20.5 (8.47)
Median (IQR)	16 (15–28)	12 (12–20)	24 (19–48.5)	20.0 (14–25.5)	12 (10.5–16)	26 (18–45)	19 (15.25–26)
Return to preferred physical activity in weeks							
Recreational level (n)	44	58	53	24	24	25	68
Mean (SD)	17.7 (6.91)	13.0 (5.26)	30.2 (14.41)	16.2 (7.02)	12.5 (6.91)	33.3 (20.92)	17.2 (6.93)
Median (IQR)	16 (12.5–23.5)	12.0 (12–16)	25 (20–45)	16 (10.5–23)	12 (8–16)	25 (20–51.5)	16 (12–23.5)
Competitive level (n)	41	54	50	24	25	24	65
Mean (SD)	25.1 (11.82)	19.4 (8.75)*	40.3 (14.13)	20.8 (6.38)	15.2 (7.31)*	35.8 (13.13)	23.5 (10.32)
Median (IQR)	24 (16–32)	18 (12–24)*	43 (28–52)	20 (16–24.75)	12 (12–20)*	34 (24–51.5)	23 (16–28)

n Number of respondents, *SD* standard deviation, *IQR* interquartile range, *AV* average, *Min* minimum, *Max* maximum

* Between group comparison $p < 0.05$

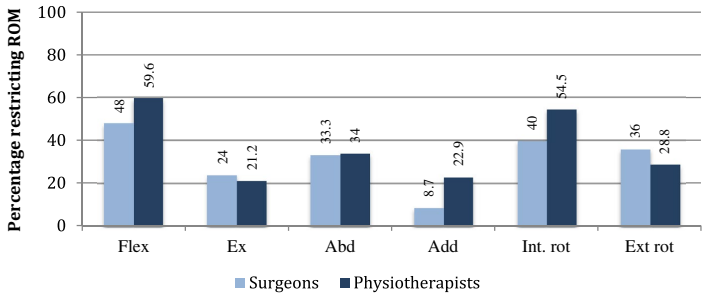


Fig. 3 Frequency (%) of recommended post-surgical ROM-restrictions. *ROM* range of motion, *Flex* flexion, *Ex* extension, *Abd* abduction, *Add* adduction, *Int. rot* internal rotation, *Ext rot* external rotation

Table 3 Rehabilitation structure and content

Profession (*n*)	Physiotherapists (62)	Surgeons (28)	*p* value*
Patients received by referral [% (*n*)]	48.4 (30/62)	–	–
Patients referred to physiotherapist [% (*n*)]	–	96.4 (27/28)	–
Rated importance of physiotherapy[a] [% (*n*)]	91.9 (57/62)	82.1 (23/28)	N. S
Number of physiotherapy meetings per month			
Median (IQR)	4 (2–6)	–	–
Number of surgical follow-ups			
Median (IQR)	–	2 (2–2)	–
Specific protocol followed/recommended [% (*n*)]	61.3 (38/62)	72 (18/25)	N. S
Protocol criteria-based/criteria- and time-based [% (*n*)]	86.7 (52/60)	77.8 (21/27)	N. S
Rated high importance of[a]			
Exercise therapy [% (*n*)]	98.4 (60/61)	85.2 (23/27)	0.029
Manual therapy [% (*n*)]	18 (11/61)	25 (7/28)	N. S
Electro-physical modalities [% (*n*)]	1.7 (1/60)	0 (0/28)	N. S
Applied evaluation of treatment by[b]			
Subjective outcomes [% (*n*)]	91.4 (53/58)	100 (26/26)	N. S
Objective outcomes [% (*n*)]	91.3 (52/56)	96.3 (26/27)	N. S
Evaluation of readiness to return to sport (RTS)[c] [% (*n*)]	74.2 (46/62)	50 (14/28)	0.024
Influence on RTS decision[d]			
Patient [% (*n*)]	80.3 (49/61)	75 (21/28)	N. S
Physiotherapist [% (*n*)]	60.7 (37/61)	46.4 (13/28)	N. S
Surgeon [% (*n*)]	48.4 (29/60)	39.3 (11/28)	N. S

n Number of respondents

* Between group comparison, Chi square test

[a] Respondents rating respective modality as either "extremely important" or "very important"

[b] Respondents reporting to "sometimes"/"always" evaluate treatment by subjective/objective outcomes

[c] Respondents reporting to evaluate readiness to return to sport

[d] Respondents rating the influence of respective roles in the return to sport decision process as "extremely influential" or "very influential"

estimated tissue healing times [13, 15, 35, 38, 39]; however, there is no current evidence favouring one specific approach. Rehabilitation protocols are generally poorly reported and demonstrate large variability [8, 18]. Until results of comparative trials are published [4, 37], clinical opinions will likely vary. Therefore, uncertainty in best practice may explain the general variability regarding the expected timeline of rehabilitation observed in our study.

More optimistic views regarding minimal expected time to return to competitive sports following HA were expressed by the surgeons in our study than by the physiotherapists. This might be due to surgeons basing recommendations

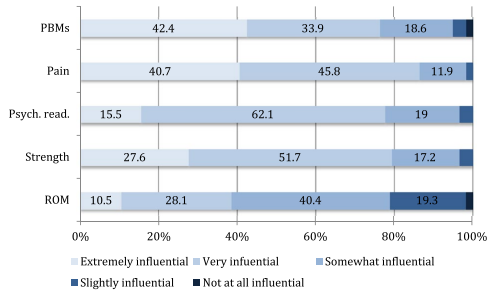


Fig. 4 Influence of different outcomes on RTS decision. *RTS* return to sport, *PBMs* performance-based measures, *Psych. read* psychological readiness, *ROM* range of motion, percentages (%) are displayed when exceeding 10% of the study sample

on biological healing times versus physiotherapists basing recommendations on clinically observable progression criteria such as normalization of pain-free gait patterns [18]. Although time to RTS is rarely reported [33] and varies greatly [5, 6, 27, 29], a recent meta-analysis reported that patient-reported improvements in sport function occur between 6 months and 1 year post-surgery [22]. However, similar to our results, surgeons from high volume HA centres recommended 12–20 weeks for athletes to return to competitive sports [14]. An objective evaluation of health status is needed to guide the athlete towards an informed RTS decision [10]. According to our results, physiotherapists more frequently evaluate RTS and rate objective measures such as PBMs and strength as very important in the RTS decision, compared with surgeons. Such objective clinical outcomes are more easily collected during frequent clinical sessions, which may be a possible explanation for the difference in use we found. This difference in direct involvement in the RTS decision could potentially also explain the difference in minimal expected time to RTS.

Generally, a combination of subjective and objective outcomes is recommended for evaluation of results of arthroscopy and following rehabilitation [20]. Surgeons more frequently reported use of PROs such as HAGOS, iHOT and HOS, which are recommended for evaluation of treatment efficacy of HA and following rehabilitation [18, 36]. Considering the fact that physiotherapists meet patients approximately four times a month, we find it surprising that not more of them use evidence-based PROs to monitor rehabilitation progression and evaluate treatment efficacy. The differing clinical working routines between professions may explain why surgeons more often use PROs, while physiotherapists more often use PBMs, in the evaluation of post-surgical outcomes. About 40% of physiotherapists and 71% of all surgeons in our study work at clinics providing both surgery and rehabilitation, and it is possible that PROs and PBMs collected by either profession, or via routine clinical follow-up, are shared between professions.

Despite being frequently advocated in current literature [15, 24, 35, 38, 39], 80% of clinicians in our study rate passive modalities such as manual therapy less important than exercise therapy, which was rated very important by almost all responding clinicians. Early restoration of motion including pain-free joint ROM is generally encouraged [18] and more than half of surgeons in our study do not recommend any restrictions in ROM following HA. There is conflicting evidence regarding improvements of ROM following HA [16] and participants in our study rated ROM to be the least influential factor in the RTS decision. The primary symptom of FAI-syndrome is pain [17], and one of the main goals of HA is to relieve pain [2]. Therefore, it is not surprising that the participants rated pain as the most influential measure in the RTS decision. Almost 80% of responding clinicians rated psychological readiness to be very influential in the RTS decision. Psychological readiness is considered an important aspect in this decision [1] but has, to our best knowledge, not been investigated in patients following HA.

A number of limitations in the current study exist. Surgeons were invited to participate by identification through participation lists of national and Scandinavian HA meetings, which led to confidence in having approached the majority of them. However, it is possible that surgeons with interest in rehabilitation were more likely to take part in the survey. This may have led to an overestimation of positive attitude towards physiotherapy. Physiotherapists were approached via sports medicine organizations using e-mail and through social media. By identifying surgical centres specialized in arthroscopy through the Scandinavian ACL-registries, contacting their respective rehabilitation departments, and through our analysis of surgeons' referral patterns, we aimed to reduce selection bias.

Considering the primarily descriptive nature of the study and the limited size of the total target population, no sample size calculation was performed prior to recruitment. Due to the inherent small sample size associated with the specialist clinician population investigated, a risk of type 2 error in the comparison of professions exists.

Little is known about the rehabilitation process following hip arthroscopy, and more research on the topic is warranted [8, 18]. This study provides a reflection of current usual care in the rehabilitation following HA for patients in Scandinavia. By investigating care practices and opinions, results of this study may instigate first steps towards establishing clinical consensus for rehabilitation following hip arthroscopy and highlight areas for future research.

Conclusions

Physiotherapists and surgeons presented very similar views on the rehabilitation process. Physiotherapy is considered very important following HA by both professions. The majority of respondents advocate either criteria-based or combined criteria- and time-based rehabilitation progression. Surgeons expected shorter time on crutches and to return to competitive sports than physiotherapists. Surgeons also used evidence-based self-reported outcomes to a greater extent than physiotherapists.

Acknowledgements Most importantly, we would like to thank all participating physiotherapists and surgeons. Furthermore, we would like to thank the Danish (DSSF), Swedish (SFAIM) and Norwegian (FIFA) sports medicine associations for their assistance with distribution of invitations for participation to their members. We would also like to thank the clinicians at Capio Artro Clinic in Stockholm who assisted in the validation of the survey.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Funding There is no funding source.

Ethical approval This article does not contain any studies handling personal information or sensitive data, including any physical engagement, or in other ways affecting the participants.

References

1. Ardern CL, Glasgow P, Schneiders A, Witvrouw E, Clarsen B, Cools A, Gojanovic B, Griffin S, Khan KM, Moksnes H, Mutch SA, Phillips N, Reurink G, Sadler R, Silbernagel KG, Thorborg K, Wangensteen A, Wilk KE, Bizzini M (2016) 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. Br J Sports Med 50(14):853–864
2. Bedi A, Kelly BT (2013) Femoroacetabular impingement. J Bone Joint Surg Am 95(1):82–92
3. Bedi A, Kelly BT, Khanduja V (2013) Arthroscopic hip preservation surgery: current concepts and perspective. Bone Joint J 95-B(1):10–19
4. Bennell KL, O'Donnell JM, Takla A, Spiers LN, Hunter DJ, Staples M, Hinman RS (2014) Efficacy of a physiotherapy rehabilitation program for individuals undergoing arthroscopic management of femoroacetabular impingement—the FAIR trial: a randomised controlled trial protocol. BMC Musculoskelet Disord 15:58
5. Bizzini M, Notzli HP, Maffiuletti NA (2007) Femoroacetabular impingement in professional ice hockey players: a case series of 5 athletes after open surgical decompression of the hip. Am J Sports Med 35(11):1955–1959
6. Boykin RE, McFeely ED, Ackerman KE, Yen YM, Nasreddine A, Kocher MS (2013) Labral injuries of the hip in rowers. Clin Orthop Relat Res 471(8):2517–2522
7. Bozic KJ, Chan V, Valone FH 3rd, Feeley BT, Vail TP (2013) Trends in hip arthroscopy utilization in the United States. J Arthroplasty 28(8 Suppl):140–143
8. Cheatham SW, Enseki KR, Kolber MJ (2015) Post-operative rehabilitation after hip arthroscopy: a search for the evidence. J Sport Rehabil 24(4):413–418
9. Colvin AC, Harrast J, Harner C (2012) Trends in hip arthroscopy. J Bone Joint Surg Am 94(4):e23
10. Dijkstra HP, Pollock N, Chakraverty R, Ardern CL (2016) Return to play in elite sport: a shared decision-making process. Br J Sports Med 51(5):419–420
11. Dippmann C, Thorborg K, Kraemer O, Winge S, Holmich P (2014) Symptoms of nerve dysfunction after hip arthroscopy: an under-reported complication? Arthroscopy 30(2):202–207
12. Dippmann C, Thorborg K, Kraemer O, Winge S, Palm H, Holmich P (2014) Hip arthroscopy with labral repair for femoroacetabular impingement: short-term outcomes. Knee Surg Sports Traumatol Arthrosc 22(4):744–749
13. Domb BG, Sgroi TA, VanDevender JC (2016) Physical therapy protocol after hip arthroscopy: clinical guidelines supported by 2-year outcomes. Sports Health 8(4):347–354
14. Domb BG, Stake CE, Finch NA, Cramer TL (2014) Return to sport after hip arthroscopy: aggregate recommendations from high-volume hip arthroscopy centers. Orthopedics 37(10):e902–e905
15. Edelstein J, Ranawat A, Enseki KR, Yun RJ, Draovitch P (2012) Post-operative guidelines following hip arthroscopy. Curr Rev Musculoskelet Med 5(1):15–23
16. Freke MD, Kemp J, Svege I, Risberg MA, Semciw A, Crossley KM (2016) Physical impairments in symptomatic femoroacetabular impingement: a systematic review of the evidence. Br J Sports Med 50(19):1180
17. Griffin DR, Dickenson EJ, O'Donnell J, Agricola R, Awan T, Beck M, Clohisy JC, Dijkstra HP, Falvey E, Gimpel M, Hinman RS, Holmich P, Kassarjian A, Martin HD, Martin R, Mather RC, Philippon MJ, Reiman MP, Takla A, Thorborg K, Walker S, Weir A, Bennell KL (2016) The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement. Br J Sports Med 50(19):1169–1176
18. Grzybowski JS, Malloy P, Stegemann C, Bush-Joseph C, Harris JD, Nho SJ (2015) Rehabilitation following hip arthroscopy—a systematic review. Front Surg 2:21
19. Gupta A, Suarez-Ahedo C, Redmond JM, Gerhardt MB, Hanypsiak B, Stake CE, Finch NA, Domb BG (2015) Best practices during hip arthroscopy: aggregate recommendations of high-volume surgeons. Arthroscopy 31(9):1722–1727
20. Irrgang JJ, Lubowitz JH (2008) Measuring arthroscopic outcome. Arthroscopy 24(6):718–722
21. Khan M, Ayeni OR, Madden K, Bedi A, Ranawat A, Kelly BT, Sancheti P, Ejnisman L, Tsiridis E, Bhandari M (2016) Femoroacetabular impingement: have we hit a global tipping point in diagnosis and treatment? Results from the InterNational Femoroacetabular Impingement Optimal Care Update Survey (IN FOCUS). Arthroscopy 32(5):779–787 e774
22. Kierkegaard S, Langeskov-Christensen M, Lund B, Naal FD, Mechlenburg I, Dalgas U, Casartelli NC (2016) Pain, activities of daily living and sport function at different time points after hip arthroscopy in patients with femoroacetabular impingement: a systematic review with meta-analysis. Br J Sports Med 51(7):572–579

23. Lund B, Mygind-Klavsen B, Gronbech Nielsen T, Maagaard N, Kraemer O, Holmich P, Winge S, Lind M (2017) Danish Hip Arthroscopy Registry (DHAR): the outcome of patients with femoroacetabular impingement (FAI). J Hip Preserv Surg 4(2):170–177
24. Malloy P, Gray K, Wolff AB (2016) Rehabilitation after hip arthroscopy: a movement control-based perspective. Clin Sports Med 35(3):503–521
25. Montgomery SR, Ngo SS, Hobson T, Nguyen S, Alluri R, Wang JC, Hame SL (2013) Trends and demographics in hip arthroscopy in the United States. Arthroscopy 29(4):661–665
26. Mygind-Klavsen B, Gronbech Nielsen T, Maagaard N, Kraemer O, Holmich P, Winge S, Lund B, Lind M (2016) Danish Hip Arthroscopy Registry: an epidemiologic and perioperative description of the first 2000 procedures. J Hip Preserv Surg 3(2):138–145
27. Nho SJ, Magennis EM, Singh CK, Kelly BT (2011) Outcomes after the arthroscopic treatment of femoroacetabular impingement in a mixed group of high-level athletes. Am J Sports Med 39(Suppl):14S–19S
28. Nielsen TG, Miller LL, Lund B, Christiansen SE, Lind M (2014) Outcome of arthroscopic treatment for symptomatic femoroacetabular impingement. BMC Musculoskelet Disord 15:394
29. Philippon MJ, Weiss DR, Kuppersmith DA, Briggs KK, Hay CJ (2010) Arthroscopic labral repair and treatment of femoroacetabular impingement in professional hockey players. Am J Sports Med 38(1):99–104
30. Sansone M, Ahlden M, Jonasson P, Thomee C, Sward L, Baranto A, Karlsson J, Thomee R (2014) A Swedish hip arthroscopy registry: demographics and development. Knee Surg Sports Traumatol Arthrosc 22(4):774–780
31. Sansone M, Ahlden M, Jonasson P, Thomee C, Sward L, Baranto A, Karlsson J, Thomee R (2015) Good results after hip arthroscopy for femoroacetabular impingement in top-level athletes. Orthop J Sports Med 3(2):2325967115569691
32. Sansone M, Ahlden M, Jonasson P, Thomee C, Sward L, Ohlin A, Baranto A, Karlsson J, Thomee R (2016) Outcome after hip arthroscopy for femoroacetabular impingement in 289 patients with minimum 2-year follow-up. Scand J Med Sci Sports 27(2):230–235
33. Sim Y, Horner NS, de Sa D, Simunovic N, Karlsson J, Ayeni OR (2015) Reporting of non-hip score outcomes following femoroacetabular impingement surgery: a systematic review. J Hip Preserv Surg 2(3):224–241
34. Sing DC, Feeley BT, Tay B, Vail TP, Zhang AL (2015) Age-related trends in hip arthroscopy: a large cross-sectional analysis. Arthroscopy 31(12):2307-13.e2
35. Spencer-Gardner L, Eischen JJ, Levy BA, Sierra RJ, Engasser WM, Krych AJ (2014) A comprehensive five-phase rehabilitation programme after hip arthroscopy for femoroacetabular impingement. Knee Surg Sports Traumatol Arthrosc 22(4):848–859
36. Thorborg K, Tijssen M, Habets B, Bartels EM, Roos EM, Kemp J, Crossley KM, Holmich P (2015) Patient-Reported Outcome (PRO) questionnaires for young to middle-aged adults with hip and groin disability: a systematic review of the clinimetric evidence. Br J Sports Med 49(12):812
37. Tijssen M, van Cingel RE, Staal JB, Teerenstra S, de Visser E, Nijhuis-van der Sanden MW (2016) Physical therapy aimed at self-management versus usual care physical therapy after hip arthroscopy for femoroacetabular impingement: study protocol for a randomized controlled trial. Trials 17:91
38. Voight ML, Robinson K, Gill L, Griffin K (2010) Postoperative rehabilitation guidelines for hip arthroscopy in an active population. Sports Health 2(3):222–230
39. Wahoff M, Ryan M (2011) Rehabilitation after hip femoroacetabular impingement arthroscopy. Clin Sports Med 30(2):463–482

Paper II

High or low return to sport rates following hip arthroscopy is a matter of definition?

A 2018 meta-analysis reports an overall return to sports (RTS) rate of 91% and high patient satisfaction following hip arthroscopy for femoroacetabular impingement syndrome ('arthroscopy' in this paper).[1] Even though three in four athletes were reported to return to pre-injury levels of sports, it remains unknown if they also reach their pre-injury level of performance. Currently, RTS is frequently defined as a binary outcome (ie, either as having returned to sport or not).

This simple definition does not reflect the complexity of the dynamic RTS process; the more complex elements that constitute RTS were highlighted in the 2016 consensus statement on RTS.[2] That statement recommends reporting RTS as a continuum from return to participation through return to sport and, finally, return to performance.[2] This letter reports RTS rates following arthroscopy according to the continuum approach. In addition, patients' satisfaction regarding RTS levels attained is presented.

Applying a cross-sectional study design, all patients undergoing arthroscopy at a single surgical clinic between 2014 and 2016 (n=208) were invited to respond to an online RTS survey and included in the study if they did not report further surgery following indexed arthroscopy (see the supplementary data). Patients were asked whether they had:

- Not returned to any sport or exercise.
- Returned to participation in a different sport or exercise than prior to hip symptoms.
- Returned to participation in the same sport or exercise but on a lower performance level.
- Returned to participation in the same sport or exercise on same or higher performance level than prior to hip symptoms.

Patients were also asked for satisfaction with their current level of sports activity (binary response yes/no) and to report time from arthroscopy to RTS (in months). Our study sample (n=127, 76% men, age 34.3 (10.13)) predominantly underwent arthroscopic cam resections. Mean time since surgery was 19.4 months (SD 10.4; range 3–39). Patients who had returned to their previous sport or exercise reported a mean RTS time of 8.1 (±3.8) months.

The majority of patients (89% (95% CI 82% to 93%)) had returned to sport when reporting RTS in traditional fashion, that is, all patients who had returned to participation in some sort of sport or exercise, which qualified them as having returned to sport. However, only 28% (95% CI 21% to 37%) participated in the same sport as prior to hip symptoms but at lower performance levels, and just 21% (95% CI 15% to 29%) participated in the same sport on same or higher performance levels. Among patients >6 months following arthroscopy, about half (46% (95% CI 37% to 56%)) reported satisfaction with current RTS level (figure 1).

By describing RTS rates on a continuum, results of this study showed that only one out of five patients participated at their previous level of performance at time of data collection. Hence, in light of our findings, previously reported RTS rates of 91%[1] appear realistic in relation to a return to participation but overly optimistic in relation to return to pre-injury level of sport and performance. Our data cannot be extrapolated to elite settings, where high return rates have been reported.[3] Our study sample comprises athletes with varying levels of sport and exercise participation. However, as the real-world population undergoing arthroscopy does not solely consist of young high-level athletes,[4] our sample may be more representative of the typical patient.

Considering the rapid increase in performed arthroscopies[5] and patient expectations that often exceed realistic outcomes,[6] the increasing importance of providing accurate information to the rising number of patients presenting to our clinics, applicable to their individual goals regarding RTS, should be acknowledged. We hope that the findings of this study can assist clinicians in creating realistic patient expectations regarding the postoperative reality following arthroscopy.

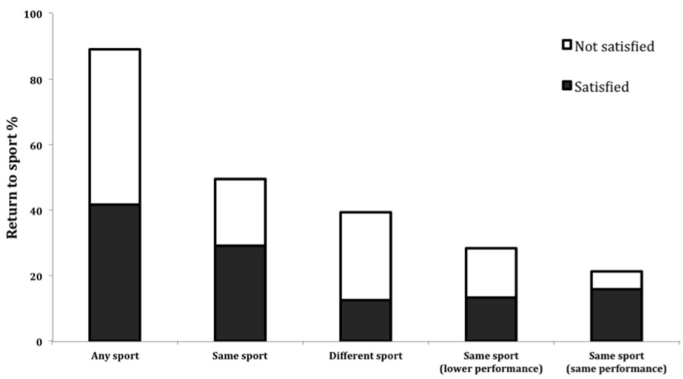


Figure 1 Return to sports rates following hip arthroscopy according to different definitions.

Tobias Wörner,[1,2] Kristian Thorborg,[3] Anders Stålman,[4] Kate E Webster,[5] Hanna Momatz Olsson,[2] Frida Eek[1]

[1]Department of Health Sciences, Lund University, Lund, Sweden
[2]Sophiahemmet, Capio Artro Clinic, Stockholm, Sweden
[3]Department of Orthopaedic Surgery, Sports Orthopaedic Research Center—Copenhagen (SORC-C), Copenhagen University Hospital, Amager-Hvidovre, Denmark
[4]Department of Molecular Medicine and Surgery, Stockholm Sports Trauma Research Center, Karolinska Institutet, Stockholm, Sweden
[5]School of Allied Health, La Trobe University, Melbourne, Victoria, Australia

Correspondence to Tobias Wörner, Department of Health Sciences, Lund University, Lund SE-22100, Sweden; tobias.worner@med.lu.se

Acknowledgements The authors would like to thank all patients participating in the study.

Contributors The study was designed by TW, FE and KT. Data collection was performed by TW, FE, AS and HMO. Data analysis was performed by TW and FE. All authors critically revised the manuscript and approved of the final version.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent Not required.

Ethics approval The study was approved by the Lund University regional ethics board (Dnr:2016/1068).

Provenance and peer review Not commissioned; externally peer reviewed.

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2018-099154).

To cite Wörner T, Thorborg K, Stålman A, *et al*. *Br J Sports Med* 2018;**52**:1475–1476.

Accepted 16 May 2018
Published Online First 1 June 2018

Br J Sports Med 2018;**52**:1475–1476.
doi:10.1136/bjsports-2018-099154

REFERENCES

1 Reiman MP, Peters S, Sylvain J, *et al*. Femoroacetabular impingement surgery allows 74% of athletes to return to the same competitive level of sports participation but their level of performance remains unreported: a systematic review with meta-analysis. *Br J Sports Med* 2018;52:972–81.
2 Ardern CL, Glasgow P, Schneiders A, *et al*. 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. *Br J Sports Med* 2016;50:853–64.
3 Casartelli NC, Leunig M, Maffiuletti NA, *et al*. Return to sport after hip surgery for femoroacetabular impingement: a systematic review. *Br J Sports Med* 2015;49:819–24.
4 Griffin DR, Dickenson EJ, O'Donnell J, *et al*. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement. *Br J Sports Med* 2016;50:1169–76.
5 Sing DC, Feeley BT, Tay B, *et al*. Age-related trends in hip arthroscopy: a large cross-sectional analysis. *Arthroscopy* 2015;31:2307–13.
6 Mannion AF, Impellizzeri FM, Naal FD, *et al*. Fulfilment of patient-rated expectations predicts the outcome of surgery for femoroacetabular impingement. *Osteoarthritis Cartilage* 2013;21:44–50.

Return to sport following hip arthroscopy in patients with femoroacetabular impingement syndrome: A cross-sectional study of return rates in patients 3-39 months after surgery

Wörner T[1, 2], Thorborg K[3], Stålman A[2, 4], Webster KE[5], Momatz Olsson H[2], Eek F[1].

[1] Department of Health Sciences, Lund University, Sweden.

[2] Capio Artro Clinic, Sophiahemmet, Stockholm, Sweden

[3] Sports Orthopaedic Research Center - Copenhagen (SORC-C), Department of Orthopaedic Surgery, Copenhagen University Hospital, Amager-Hvidovre, Denmark

[4] Department of Molecular Medicine and Surgery, Stockholm Sports Trauma Research Center, Karolinska Institutet, Stockholm, Sweden.

[5] School of Allied Health, La Trobe University, Melbourne, Australia

Corresponding author:
Tobias Wörner
Lund University, Department of Health Sciences, Box 157, SE-22100 Lund
Phone: +46 72 0404559
E-mail: tobias.worner@med.lu.se

Key words: *FAI; Hip arthroscopy; Return to Sports; Performance*

ABSTRACT

Objectives

The primary aim of this study was to describe return to sport (RTS) following hip arthroscopy (HA) for femoroacetabular impingement syndrome (FAIS). The secondary aim was to examine patient satisfaction with RTS-levels reached as well as to describe patient reported time to RTS.

Methods

Patients operated for FAIS between 2014-2016 (n=208) were invited to respond to an online-survey. RTS was assessed on a continuum from (a) no return to sport or exercise, return to (b) different sport/exercise (c) same sport/exercise at lower performance-level (d) same sport/exercise at same performance-level. Time to RTS was defined as time between HA and return to previous (pre-symptomatic) sport or exercise

Results

The final sample consisted of 127 patients (mean age: 34.3 years [SD=10.2); mean time post-HA=19.4 months [SD=10.4]). In total, 89% of patients had returned to some sort of sport or exercise. However, only 50% returned to same sport [21.4% to same- and 28.3% to lower performance-levels] and 39% returned to participation in a different sport. Eleven percent had not returned to any form of sport/exercise.

Conclusions

Defining RTS following HA as continuum revealed that only half of all patients returned to the same sports/exercise as prior to hip symptoms, and just a fifth reported a return to previous performance-levels. Hence, traditional definitions may yield overly optimistic results, and not reflect the complete RTS-picture needed for clinicians aiming to create realistic patient expectations.

INTRODUCTION

Hip arthroscopy (HA) is an orthopedic procedure, used to treat femoroacetabular impingement syndrome (FAIS) in physically active, young and middle-aged patients[1]. The worldwide number of patients undergoing HA has been increasing dramatically [2-5], and is expected to keep rising [6]. Satisfaction with HA is strongly predicted by the fulfillment of patient's expectations regarding return to sport (RTS) [7]. However, just a fraction of studies investigating efficacy of HA report RTS outcomes [8]. Furthermore, when reported, it often lacks a clear definition and definitions vary between studies [9]

A systematic review from 2015 on RTS following HA for FAIS reported that 87% of patients returned to sport and 82% returned to previous levels [9]. This high rate of RTS has since been confirmed by a 2018 systematic review and meta-analysis, reporting that while 91% return to sport at any level just 74% return to sport at their previous levels [10]. The discrepancy between the rate of patients returning to any level of sport and the rate of patients returning to their previous levels indicates that the definition of RTS matters. Yet, current studies frequently define RTS as binary outcome; either having returned to sport or not [11-14]. This simplistic definition may not reflect the complexity of RTS, which is a dynamic process paralleling recovery and rehabilitation.

A recent consensus statement recommended reporting RTS on a three-part continuum from return to participation, over return to sport, then finally return to full performance at the same or higher level. The consensus statement also recommended assessing satisfaction with achieved RTS-levels [15]. To the authors' best knowledge no

existing study reports RTS-rates in HA patients following the recommendations of the RTS consensus statement [15].

The primary aim of the study was to describe RTS-rates, defined as a continuum from (a) no return, or return to (b) different sport or exercise than prior to hip symptoms (c) same sport or exercise as prior to hip symptoms at a lower performance level or (d) same sport or exercise as prior to hip symptoms at the same level of performance, in a group of previously sport- or exercise-active patients from 3-36 months following HA for FAIS. Secondly we aimed to describe patient satisfaction with reached RTS-levels as well as patient reported time to RTS, defined as return to same (pre-symptomatic) sport or exercise.

METHODS

Study design

This cross-sectional study was approved by the Ethics Committee at Lund University (Dnr:2016/1068) and conformed to the provision of the Declaration of Helsinki. Reporting of findings follows the STROBE guidelines [16].

Sample and procedures

Patients who underwent HA between 2014 and 2016 (3-39 months post-operative at time of inclusion) were identified through a journal search for diagnostic codes [International classification of diseases 10 (ICD10) treatment codes for: Labrum repair (NFT99); Labrum resection (NFH91); Rim trimming (NEK19); Cam resection (NFK19)]. Identified patients were eligible if they (a) were ≥18 years old; (b) received HA for FAIS (Cam-, pincer-resection or combination) ≥ three month prior to

data collection; (c) participated in sports/exercise [Hip Sports Activity Scale (HSAS) ≥ 1] before surgery; (d) did not have had any further surgery following their indexed HA.

Between April and May 2017, eligible patients were invited to participate in a web-based survey. Two subsequent reminders were sent to non-responders. Since it could not be assumed that retrieved e-mail addresses were up to date, a paper version of the survey was also sent by regular mail.

Surgical technique and post-operative rehabilitation

HA was performed according to standardized clinical procedures, with the patient in a supine position using antero-lateral and mid-anterior portals. Access to the peripheral compartment was achieved through capsulotomy parallel to the ilio-femoral ligament and a transverse cut, kept as small as possible in order to minimize iatrogenic increase in hip laxity. For access to the central compartment an axial traction was used. No capsular closure was performed at the end of surgery. Pincer morphology was preferably addressed with an "over-the –top technique", through resection of the acetabular rim with the labrum left in situ. When the labrum had to be released it was re-fixed with suture anchors (Suture-Fix, Smith & Nephew, Andover, Mass, USA). CAM morphologies were thoroughly resected from far lateral to far medial, caudal and posterior. At the end of surgery a meticulous fluoroscopic and dynamic assessment was made in order to avoid remaining impingement.

Patients were rehabilitated either by local community physiotherapists or at the operating clinic. On discharge, all patients received the same home-training program, which aimed to improve range of motion, prevent intra-articular adhesions and

maintain lower extremity and abdominal muscle function. Patients were recommended to book a first physiotherapy appointment one week after surgery with the recommendation to follow a standardized rehabilitation protocol provided by the clinic. The four-phase protocol describes specific goals, pitfalls, and suggested exercises/activities for each phase, from surgery to RTS. Expected time-lines are given for each phase, considering biological tissue healing times; while it is emphasized that progression should be tailored to the individual patient and based on achieving the phase-specific goals.

Data collection

Background/descriptive data

Data regarding performed arthroscopic procedures as well as cartilage defects at the time of surgery was retrospectively retrieved by review of patient charts, surgical reports and arthroscopic imaging taken during surgery. In the survey, patients were asked for age, gender, side of affected hip(s), and any potential further surgeries following the initial HA. Current, as well as pre-symptomatic activity levels were measured by the Hip Sports Activity Scale (HSAS) [17].

Outcome measures

Patients were asked to report current RTS-levels according to whether they had (a) not returned to sport (did not participate in any sport or exercise, "No sport") or returned to (b) general participation in any sport or exercise, other than prior to hip symptoms ("Different sport") (c) participation in same sport or exercise as prior to hip symptoms but a on lower performance level or ["Same sport (lower performance)"] (d) participation in same sport or exercise on same or higher performance level than

prior to hip symptoms ["Same sport (same performance)"]. Furthermore, patients were asked for satisfaction with their current level of sports activity (binary response yes/no), and to report time from HA to RTS (in months).

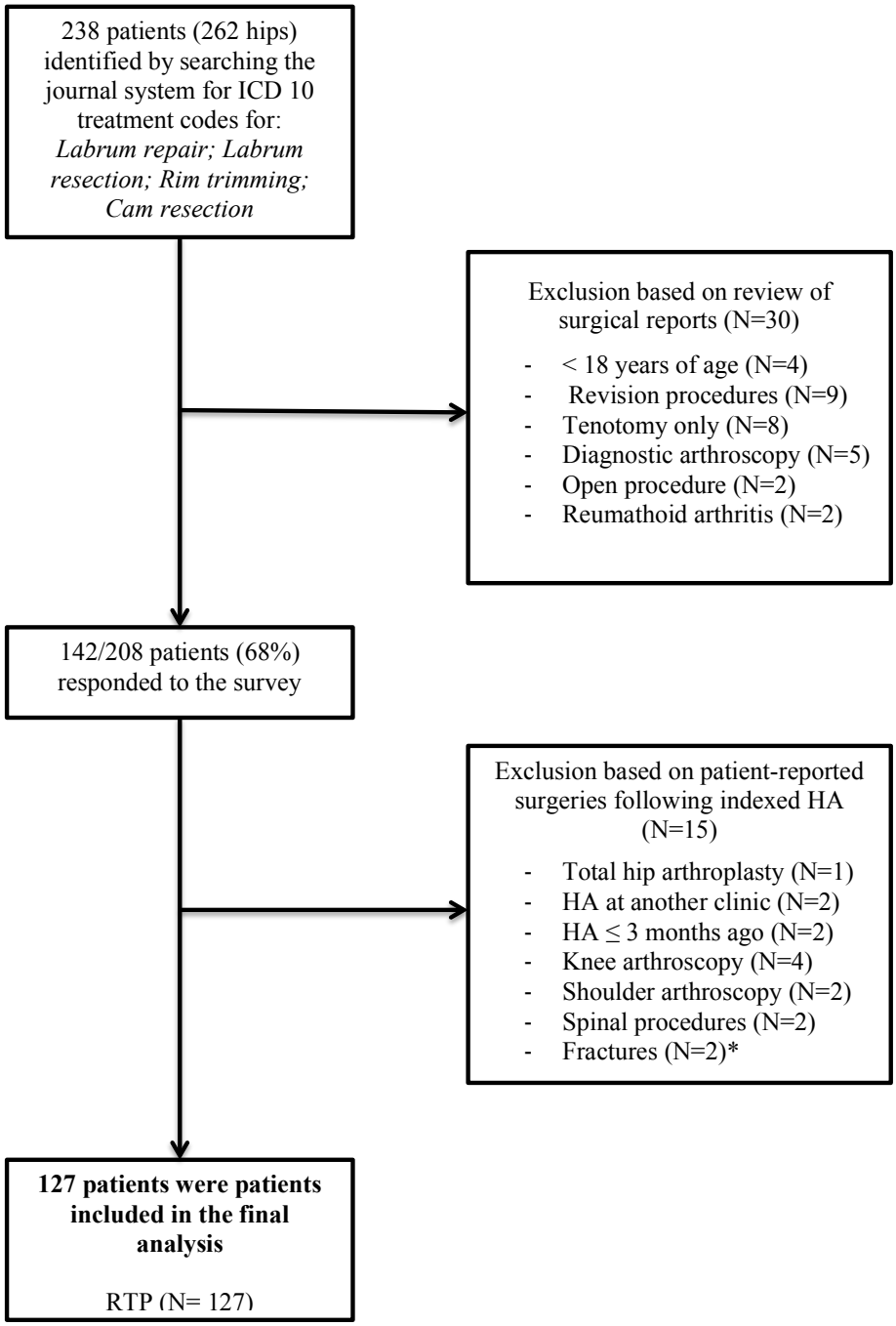
Statistical analysis

Percentage of patients having reached the different RTS-levels, with accompanying 95% confidence intervals, and satisfaction with the level of RTS reached was presented for the whole sample as well as stratified into subgroups according to time since surgery in months (>3-6; >6-12; >12-18; >18-24; >24-39). Median HSAS levels (pre-operative/post-operative) were calculated. All statistical management was performed in SPSS (Version 23.0, Armonk, NY: IBM Corp.).

RESULTS

Among 208 eligible patients, 142 (68%) responded. Patients that reported further surgery after initial HA (N=15) were excluded from data analysis (Figure 1). The final sample (N=127) predominantly consisted of male participants undergoing cam-resections. Mean time since surgery was 19.4 months (SD 10.4; Range 3-39) at the time of follow up and participants reported a median HSAS score of 3.5 (IQR: 2-5), with a median decrease of 2 HSAS levels (IQR: -3 – 0) compared with prior to symptoms. The most common pre-symptomatic sports were soccer and ice hockey. A detailed description of the study sample is provided in table 1.

Figure 1: Patient flow into the study



* No fractures related to the hip joint (1 clavicel; 1 elbow)

Table 1: Patient demographics (N=127)

Age in years) [Mean (SD); range]	34.26 (10.13) 17-60
Gender [%(n)]	
Females	24.4 (31)
Males	75.6 (96)
HSAS before symptoms (N=126)	
Mean (SD)	5.47 (1.93)
Median (IQR)	5 (4-7)
Time from surgery to follow up in months [Mean (SD); range];	19.4 (10.4); 3-39
[Median (IQR)]	18.3 (10.8-25.9)
Current hip-related function [Mean (SD)]	
iHOT 12	68.2 (24.4)
HAGOS subscale sports and recreation	65.4 (24.2)
HAGOS subscale physical activity	82.5 (14.5)
Pre-symptomatic sports [%(n)]*	
Team sports	44.0 (51)
Gym-based sports	35.3 (41)
Endurance sports	27.8 (32)
Other sports	34.2 (40)
Operated hip [%(n)]	
Right	48.4 (62)
Left	34.6 (44)
Bilateral	16.5 (21)
Description of performed arthroscopic procedures (N=125)	
CAM-resection [%(n)]	98.4 (123)
Combined CAM & Pincer [%(n)]	12.8 (16)
CAM-resection + microfracture [%(n)]	3.1 (4)
CAM resection + tenotomy [%(n)]	1.6 (2)
Labrum stabilization [%(n)]	24 (30)
Labrum re-fixation [%(n)]	3.9 (5)
Cartilage defects [%(n)]	65.4 (83)
Acetabular cartilage defect (N=123)	
Outerbridge classification [%(n)]	63 (78)
1 = Rough surface; chondral softening	1 = 20.3 (25)
2 = Irregular surface defects; <50% cartilage thickness	2 = 12.2 (15)
3 = Loss of >50% cartilage thickness	3 = 11.4 (14)
4 = Cartilage loss, exposed bone	4 = 19.5 (24)
Femoral cartilage defect (N=123)	
Outerbridge classification [%(n)]	8.9 (11)
1 = Rough surface; chondral softening	1 = 4.1 (5)
2 = Irregular surface defects; <50% cartilage thickness	2 = 0.8 (1)
3 = Loss of >50% cartilage thickness	3 = 1.6 (2)
4 = Cartilage loss, exposed bone	4 = 1.6 (2)

N = Number; SD = Standard deviation; % = Percentage; iHOT12 = International Hip Outcome Tool; HAGOS = Copenhagen Hip And Groin Outcome Score;

* Reported team sports: Soccer; Ice hockey; Floorball; Basketball; Handball
Endurance sports: Running; Cycling
Other sports: Tennis, Golf, Skiing, Gymnastics, Dance etc.
Participants could report more than one sport

The majority of patients [89% (95%CI: 82%-93%)] had returned to some sort of participation in sports or exercise at follow up. However, just 21% (95%CI: 15–29%) participated in the same sport as prior to hip symptoms, on same or higher performance levels, 28% (95%CI: 21-37%) participated in same sport but at lower performance levels. The highest proportion of patients that had returned to their previous sports was found in groups between 6 and 24 months post-surgery. Return-rates to the different categories across the RTS-continuum for all participants together, as well as stratified according to time since surgery are illustrated in table 2.

Table 2: Return to sport rates at different time point

	Stratification according to time since surgery in months					
Reached level of RTS [%(n)]	>3-39 (N=127)	>3–6 (N=15)	>6–12 (N=24)	>12–18 (N=23)	>18–24 (N=15)	>24–39 (N=50)
No return to sport/exercise	11 (14)	23.1 (3)	4.2 (1)	4.3 (1)	-	18 (9)
Return to diff. sport/exercise	39.4 (50)	38.5 (6)	37.2 (9)	43.5 (10)	33.3 (5)	40 (20)
Return to same sport at lower performance level	28.3 (36)	30.8 (5)	29.2 (7)	26.1 (6)	33.3 (5)	26 (13)
Return to same sport at same performance level	21.3 (27)	7.7 (1)	29.2 (7)	26.1 (6)	33.3 (5)	16 (8)

Among patients >6 months post HA, about half [46.4% (95%CI: 37-56%)] reported to be satisfied with current activity levels. Higher proportions were observed in groups with higher levels of sport or exercise participation. The only group with more satisfied than not- satisfied patients, was the group who had returned to the same or higher level of performance (Figure 2). Patients who had returned to their previous sport or exercise reported a mean RTS-time of 8.1 (+/-3.8) months.

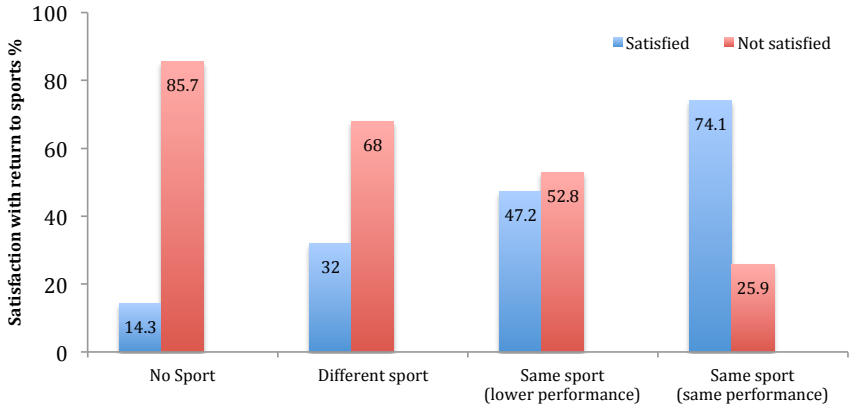


Figure 2: Satisfaction with return to sports levels >6months post hip arthroscopy (N=114)

DISCUSSION

By describing RTS-rates on a continuum, results of this study showed that although almost 90% of all participants returned to some sort of sport or exercise, return-rates to same sport or exercise was only achieved by 50% and only a fifth participated at their previous performance level at time of data collection. Hence, in light of our findings, previously reported RTS-rates in patients following HA for FAIS appear overly optimistic [9-12 14 18]. The most apparent reason for the high return-rates in previous studies and the low rates in the current study is how RTS was defined. The previous studies defined RTS as binary outcome [11-14], whereas we defined RTS as different levels of a staged process as recommended by a recent consensus statement on RTS [15].

Sansone et al. [19] used HSAS scores to define RTS-levels and reported that only 52% of athletes in their sample returned to their previous activity levels after HA. Whilst

this result is more similar with our data, a smaller percentage of participants in our study, just 21%, reported participation at previous performance levels. This difference may however be explained by differences in studied populations. While the study by Sansone et al. investigated high-level athletes [19], our sample was older and had lower pre-operative activity levels. High-level athletes have been shown to have higher RTS-rates than recreational athletes [9]. As the total population undergoing HA does not solely consist of young high-level athletes [20], results of our study may be more representative for the general physically active population undergoing FAIS-surgery. Investigating a comparable population in a similar design, a study by Tijssen et al., including 37 patients following HA, reported similar RTS-rates to the ones found in our study. In their study, 84% of patients returned to general sport participation but only 19% returned to the same sport as before [21].

The highest proportions of patients that had returned to same sports were observed in time-groups 6-24 months post-operative. The return-rate was lower in both the <6 and >24 month groups. While these numbers should be interpreted with caution due to small sub-group sizes, parallels can be drawn with the existing literature. According to a recent systematic review, patients recover ADL function 3-6 months post FAIS-surgery, while improvements in sport-specific function occurs between 6 and 12 months [22]. We observed the highest return-rates within this expected timeframe for recovery of sport-specific function. A possible explanation for the relatively lower RTS-rates ≥ 24 months post-surgery could be the that we asked for current RTS-status, and some participants could potentially have returned to sports but ceased participation again, for other reasons than hip-related problems. Earlier than 6-months post-surgery, fewer patients can be expected to have recovered that level of

functioning [22], which also is reflected by our results. On the contrary, rehabilitation protocols provided by North American surgeons report median times to return to running and sports to be 12 and 15 weeks post HA [23]. Participants in our study reported a mean RTS-time of 8 (+/-4) months, which is similar to other cohort studies [18 24] but longer than that currently expected by surgeons and physiotherapists [23 25 26]. Future prospective studies, defining RTS on a continuum, are needed to accurately describe the patient's journey through the RTS-continuum while taking other factors potentially influencing the return into account.

Clinical implications

Most patients undergoing arthroscopic surgery expect to be able to RTS [27 28]. In patients undergoing HA, these expectations have been shown to be overly optimistic [7]. Our findings highlight that actual RTS-rates, when defined as a return to same sport and level of performance, are not as high as previously reported [9 10]. Likewise, patient satisfaction, which has been reported to be high in previous RTS-studies [10], was observed to differ between patients that had reached different stages on the continuum with most satisfied patients among those returned to the same sport and level of performance. Findings of this study may therefore assist clinicians in providing balanced and accurate information to patients in order to create realistic expectations about post-operative reality concerning RTS-rates.

Methodological considerations

The final response rate to the survey was 68%. We see no obvious reason to suspect that any certain group of patients, based on their RTS-status, would be more or less inclined to respond. Hence, we don't expect our results to be affected by an

underlying response bias. Inclusion of participants at a wide range of times since surgery may have affected the main outcome RTS, which is a time sensitive measure. Participants responded to the survey at different time points in their rehabilitation process and not all may have reached the end point of rehabilitation. However, no big differences in RTS-rates between individual time groups >6 months post-operative were observed, which indicates that time as such may not have affected RTS-rates much once half a year had passed. Finally, the sample included in this study was homogeneous with regard to the arthroscopic procedure, which is a strength of this study. Resection of CAM-morphology was the main procedure performed in 98.4% of all patients and resection of pincer-morphology almost exclusively performed in combination with CAM-resection. All surgeries were performed at the same surgical center according to the same surgical protocol.

CONCLUSION

Similar to previous reports, which defined RTS as binary outcome, almost 9 out of 10 patients had returned to some sort of sport or exercise after HA for FAIS. However, defining RTS on a continuum reveals that just half of all patients had returned to the same sport and only 1 out of 5 had returned to the same performance levels as prior to hip symptoms.

What are the new findings?

- When defining RTS as binary (yes/no) outcome 9 in 10 patients had returned to sport or exercise after HA, which is comparable to previous reports
- When defining RTS on a continuum:

  - Half of all patients had returned to the same sport as prior to hip symptoms
  - One in five patients had returned to the same sport on the same or higher performance level than prior to hip symptoms

REFERENCES

1. Bedi A, Kelly BT, Khanduja V. Arthroscopic hip preservation surgery: current concepts and perspective. *Bone Joint J* 2013;95-B(1):10-9. doi: 10.1302/0301-620X.95B1.29608.
2. Bozic KJ, Chan V, Valone FH, 3rd, et al. Trends in hip arthroscopy utilization in the United States. *J Arthroplasty* 2013;28(8 Suppl):140-3. doi: 10.1016/j.arth.2013.02.039. Epub 13 Aug 1.
3. Colvin AC, Harrast J, Harner C. Trends in hip arthroscopy. *The Journal of bone and joint surgery American volume* 2012;94(4):e23. doi: 10.2106/JBJS.J.01886
4. Montgomery SR, Ngo SS, Hobson T, et al. Trends and demographics in hip arthroscopy in the United States. *Arthroscopy* 2013;29(4):661-5. doi: 10.1016/j.arthro.2012.11.005. Epub 13 Feb 1.
5. Sing DC, Feeley BT, Tay B, et al. Age-Related Trends in Hip Arthroscopy: A Large Cross-Sectional Analysis. *Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association* 2015 doi: 10.1016/j.arthro.2015.06.008
6. Khan M, Ayeni OR, Madden K, et al. Femoroacetabular Impingement: Have We Hit a Global Tipping Point in Diagnosis and Treatment? Results From the InterNational Femoroacetabular Impingement Optimal Care Update Survey (IN FOCUS). *Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association* 2016;32(5):779-87 e4. doi: 10.1016/j.arthro.2015.10.011
7. Mannion AF, Impellizzeri FM, Naal FD, et al. Fulfilment of patient-rated expectations predicts the outcome of surgery for femoroacetabular impingement. *Osteoarthritis and cartilage / OARS, Osteoarthritis Research Society* 2013;21(1):44-50. doi: 10.1016/j.joca.2012.09.013
8. Sim Y, Horner NS, de Sa D, et al. Reporting of non-hip score outcomes following femoroacetabular impingement surgery: a systematic review. *J Hip Preserv Surg* 2015;2(3):224-41. doi: 10.1093/jhps/hnv048
9. Casartelli NC, Leunig M, Maffiuletti NA, et al. Return to sport after hip surgery for femoroacetabular impingement: a systematic review. *British journal of sports medicine* 2015;49(12):819-24. doi: 10.1136/bjsports-2014-094414
10. Reiman MP, Peters S, Sylvain J, et al. Femoroacetabular impingement surgery allows 74% of athletes to return to the same competitive level of sports participation but their level of performance remains unreported: a systematic review with meta-analysis. *British journal of sports medicine* 2018 doi: 10.1136/bjsports-2017-098696
11. Menge TJ, Bhatia S, McNamara SC, et al. Femoroacetabular Impingement in Professional Football Players: Return to Play and Predictors of Career Length After Hip Arthroscopy. *The American journal of sports medicine* 2017:363546517700118. doi: 10.1177/0363546517700118
12. Mohan R, Johnson NR, Hevesi M, et al. Return to Sport and Clinical Outcomes After Hip Arthroscopic Labral Repair in Young Amateur Athletes: Minimum 2-Year Follow-Up. *Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North*

America and the International Arthroscopy Association 2017 doi: 10.1016/j.arthro.2017.03.011
13. Newman JT, Saroki AJ, Briggs KK, et al. Return to Elite Level of Play and Performance in Professional Golfers After Arthroscopic Hip Surgery. *Orthop J Sports Med* 2016;4(4):2325967116643532. doi: 10.1177/2325967116643532
14. Weber AE, Kuhns BD, Cvetanovich GL, et al. Amateur and Recreational Athletes Return to Sport at a High Rate Following Hip Arthroscopy for Femoroacetabular Impingement. *Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association* 2017;33(4):748-55. doi: 10.1016/j.arthro.2016.10.015
15. Ardern CL, Glasgow P, Schneiders A, et al. 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. *British journal of sports medicine* 2016;50(14):853-64. doi: 10.1136/bjsports-2016-096278
16. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS medicine* 2007;4(10):e296. doi: 10.1371/journal.pmed.0040296
17. Naal FD, Miozzari HH, Kelly BT, et al. The Hip Sports Activity Scale (HSAS) for patients with femoroacetabular impingement. *Hip international : the journal of clinical and experimental research on hip pathology and therapy* 2013;23(2):204-11. doi: 10.5301/hipint.5000006
18. Degen RM, Fields KG, Wentzel CS, et al. Return-to-play rates following arthroscopic treatment of femoroacetabular impingement in competitive baseball players. *The Physician and sportsmedicine* 2016;44(4):385-90. doi: 10.1080/00913847.2016.1226123
19. Sansone M, Ahlden M, Jonasson P, et al. Good Results After Hip Arthroscopy for Femoroacetabular Impingement in Top-Level Athletes. *Orthop J Sports Med* 2015;3(2):2325967115569691. doi: 10.1177/2325967115569691
20. Griffin DR, Dickenson EJ, O'Donnell J, et al. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement. *British journal of sports medicine* 2016;50(19):1169-76. doi: 10.1136/bjsports-2016-096743
21. Tijssen M, van Cingel R, de Visser E, et al. A clinical observational study on patient-reported outcomes, hip functional performance and return to sports activities in hip arthroscopy patients. *Physical therapy in sport : official journal of the Association of Chartered Physiotherapists in Sports Medicine* 2016;20:45-55. doi: 10.1016/j.ptsp.2015.12.004
22. Kierkegaard S, Langeskov-Christensen M, Lund B, et al. Pain, activities of daily living and sport function at different time points after hip arthroscopy in patients with femoroacetabular impingement: a systematic review with meta-analysis. *British journal of sports medicine* 2016 doi: 10.1136/bjsports-2016-096618
23. Cvetanovich GL, Lizzio V, Meta F, et al. Variability and Comprehensiveness of North American Online Available Physical Therapy Protocols Following Hip Arthroscopy for Femoroacetabular Impingement and Labral Repair. *Arthroscopy : the journal of arthroscopic & related surgery : official*

publication of the Arthroscopy Association of North America and the International Arthroscopy Association 2017 doi: 10.1016/j.arthro.2017.06.045
24. Levy DM, Kuhns BD, Frank RM, et al. High Rate of Return to Running for Athletes After Hip Arthroscopy for the Treatment of Femoroacetabular Impingement and Capsular Plication. *The American journal of sports medicine* 2017;45(1):127-34. doi: 10.1177/0363546516664883
25. Domb BG, Stake CE, Finch NA, et al. Return to sport after hip arthroscopy: aggregate recommendations from high-volume hip arthroscopy centers. *Orthopedics* 2014;37(10):e902-5. doi: 10.3928/01477447-20140924-57
26. Worner T, Thorborg K, Moksnes H, et al. Similar views on rehabilitation following hip arthroscopy among physiotherapists and surgeons in Scandinavia: a specialized care survey. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA* 2017 doi: 10.1007/s00167-017-4676-6
27. Sonesson S, Kvist J, Ardern C, et al. Psychological factors are important to return to pre-injury sport activity after anterior cruciate ligament reconstruction: expect and motivate to satisfy. *Knee surgery, sports traumatology, arthroscopy : official journal of the ESSKA* 2017;25(5):1375-84. doi: 10.1007/s00167-016-4294-8
28. Warth RJ, Briggs KK, Dornan GJ, et al. Patient expectations before arthroscopic shoulder surgery: correlation with patients' reasons for seeking treatment. *Journal of shoulder and elbow surgery* 2013;22(12):1676-81. doi: 10.1016/j.jse.2013.05.003

Paper III

Original Research

Hip Function 6 to 10 Months After Arthroscopic Surgery

A Cross-sectional Comparison of Subjective and Objective Hip Function, Including Performance-Based Measures, in Patients Versus Controls

Tobias Wörner,*†‡ MSc, Johanna Nilsson,§ MSc, Kristian Thorborg,‖ PhD, Viktor Granlund,‡ BSc, Anders Stålman,‡¶ PhD, and Frida Eek,† PhD

Investigation performed at Lund University, Lund, Sweden

Background: Little is known about hip-related function, mobility, and performance in patients after hip arthroscopic surgery (HA) during the time that return to sports can be expected.

Purpose: To evaluate measures of subjective and objective hip function 6 to 10 months after HA in patients compared with healthy controls and to compare objective function in the HA group between the operated and nonoperated hips.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: A total of 33 patients who had undergone HA (mean, 8.1 ± 2.6 months postoperatively) and 33 healthy participants matched on sex, age, and activity level were compared regarding subjective hip function (Copenhagen Hip and Groin Outcome Score [HAGOS]) and objective function including hip range of motion (ROM; flexion, internal rotation, and external rotation), isometric hip muscle strength (adduction, abduction, flexion, internal rotation, and external rotation), and performance-based measures: the Y Balance Test (YBT), medial and lateral triple-hop test, and Illinois agility test. Group differences were analyzed using independent-samples *t* tests. Paired-samples *t* tests were used for a comparison of the operated and nonoperated hips. Standard effect sizes (Cohen *d*) were provided for all outcomes.

Results: The HA group reported worse subjective hip function than the control group (HAGOS subscores: $d = –0.7$ to $–2.1$; $P \leq .004$). Objective measures of hip ROM ($d = –0.5$ to $–1.1$; $P \leq .048$), hip flexion strength ($d = –0.5$; $P = .043$), and posteromedial reach of the YBT ($d = –0.5$; $P = .043$) were also reduced in the HA group, although there were no significant differences between groups regarding the remaining objective measures ($d = –0.1$ to $–0.4$; $P \geq .102$ to $.534$). The only significant difference between the operated and nonoperated hips in the HA group was reduced passive hip flexion ($d = –0.4$; $P = .045$).

Conclusion: Patients who had undergone HA demonstrated reduced subjective hip function compared with controls 6 to 10 months after surgery, when return to sports can be expected. While most objective strength and performance test results were comparable between the HA and control groups at 6 to 10 months after surgery, the HA group presented with impairments related to hip mobility and hip flexion strength. No consistent pattern of impairments was found in operated hips compared with nonoperated hips.

Keywords: femoroacetabular impingement; hip arthroscopic surgery; physical therapy/rehabilitation; athletic performance; muscle strength; range of motion

Femoroacetabular impingement syndrome (FAIS) is a motion-related clinical disorder of the hip affecting physically active patients.[13] Patients with FAIS often undergo hip arthroscopic surgery (HA) with the goal to return to sports.[26] However, despite high rates of return to general sports participation,[33] recent studies have reported that only approximately half of all athletes return to their previous sports and that just 1 in 5 return to previous performance levels.[15,49] Furthermore, patients often present with residual hip pain and reduced self-reported sporting function after HA.[19,40] More knowledge regarding the functional performance of patients who have undergone HA is

The Orthopaedic Journal of Sports Medicine, 7(6), 2325967119844821
DOI: 10.1177/2325967119844821

needed to identify impairments that may be responsible for reduced self-reported sporting function and low rates of return to performance.

Athletes with FAIS who undergo HA often do so with the aim of reducing hip pain and eliminating physical impairments that affect sports performance.[6] Examples of physical impairments that have been observed in patients with FAIS are reduced hip muscle strength[10,11] and reduced dynamic range of motion (ROM) during gait.[10] While strength has been shown to improve after HA and subsequent rehabilitation, results regarding ROM have been conflicting.[10,11] Less than 25% of studies on the surgical treatment of FAIS have reported on postoperative ROM, and only a fraction (2.5%) have reported on hip muscle strength.[32]

In addition to specific impairments such as reduced ROM and muscle strength, performance-based measures (PBMs) such as hop, balance, or change-of-direction tests, which reflect normal athletic requirements, can be conducted in a clinical setting.[22] However, there are currently only a small number of studies reporting on PBMs in patients after FAIS surgery.[7,17,43] More than 2 years after HA, participants in a study by Tijssen et al[43] performed within 90% of the limb symmetry index during tests of single-leg balance, single-leg squat control, and single-leg hop. Two further studies compared patients 1 to 2 years after HA with a control group and reported decreased single-leg squat control as well as reduced hop and single-leg bridge performance.[7,17] A 2015 systematic review on return to sports after HA recommended the implementation of PBMs as a means of monitoring rehabilitation progress and athletic abilities to meet the specific demands required to return to sports.[6]

Patients typically report improvements in hip-related sports function 6 to 12 months after HA[19] but still show marked impairments in perceived sporting ability 12 months after arthroscopic treatment.[40] While the mean time to return to sports for athletes after HA is 7 ± 2.6 months,[33] the extent to which objective hip function such as ROM and strength has recovered at this point in time is currently unknown. Potential impairments in specific hip functions may be responsible for patients' perceived impairments as well as restrictions in sports participation and hence should be recognized. Yet, there is a lack of studies investigating patients' ability to perform hip-challenging tasks with relevance to sports performance, especially during the time when these patients usually return to sports. Thus, there is a need for studies investigating these objective hip functions in patients who have undergone FAIS surgery to identify potential physical impairments, and thereby potential targets for treatment, that will inform future rehabilitation programs.[10]

The purpose of this study was to compare subjective and objective hip-related function, assessed by patient-reported measures as well as objective measures such as ROM, strength, and PBMs, between patients 6 to 10 months after HA and asymptomatic controls. Furthermore, we aimed to compare objective function of the operated hip in relation to the nonoperated hip in the HA patients.

METHODS

Study Design

This cross-sectional study compared patient-reported and objectively measured hip function between patients after HA for FAIS (6-10 months postoperatively) and a control group of asymptomatic participants. The follow-up time was chosen to reflect the time frame in which patients are reported to return to sports after HA. The recruitment of participants and data collection were performed between November 2016 and May 2017. The reporting of results conforms to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.[45] This study was approved by Lund University's regional ethics board.

Participants

Patients were recruited from a single surgical center specializing in arthroscopic surgery. Patient selection was based on International Classification of Diseases–10th Revision treatment codes (labrum repair [NFT99], labrum resection [NFH91], rim trimming [NEK19], and cam resection [NFK19]). Patients were included if they (1) had undergone primary HA for FAIS 6 to 10 months before inclusion (February-November 2016; for bilaterally operated patients, the time interval was counted from the most recent surgical procedure), (2) were ≥18 years of age, and (3) lived in the greater Stockholm area. A control group was matched with patients in the HA group according to sex, age, and type of sports/physical activity as well as respective level of participation before hip symptoms according to the Hip Sports Activity Scale (HSAS).[27] Inclusion criteria for control participants were (1) no history of hip surgery, (2) age ≥18 years, and (3) no treatment for back pain and/or injuries in the lower extremities within the past 6 months. Control

*Address correspondence to Tobias Wörner, MSc, Department of Health Sciences, Lund University, Box 157, 221 00 Lund, Sweden (email: tobias.worner@med.lu.se) (Twitter: @wuninho).
†Department of Health Sciences, Lund University, Lund, Sweden.
‡Capio Artro Clinic, Stockholm, Sweden.
§Linnaeus University, Kalmar, Sweden.
‖Sports Orthopaedic Research Center–Copenhagen (SORC-C), Department of Orthopaedic Surgery, Copenhagen University Hospital, Amager-Hvidovre, Denmark.
¶Department of Molecular Medicine and Surgery, Stockholm Sports Trauma Research Center, Karolinska Institutet, Stockholm, Sweden.
The authors declared that there are no conflicts of interest in the authorship and publication of this contribution. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.
Ethical approval for this study was obtained from Lund University's regional ethics board (No. 2016/472).

participants were recruited consecutively from local sports clubs in an effort to match included patients regarding sex, age, and type of sports as well as level of sports participation.

Assessment Procedure

Before testing, participants provided informed consent as well as demographic information such as profession, hours of exercise per week, leg dominance, and history of lower extremity surgery. Subsequently, patient-reported outcomes, in Swedish or English, were collected through a web survey, and anthropometric measures (body weight, body height, and leg length [distance between the anterior superior iliac spine and medial malleolus in cm]) were obtained. Physical testing was performed in the order described below. To minimize potential learning effects during PBMs, participants were allowed to practice the tests until they felt sufficiently prepared. Furthermore, additional trials for strength measures as well as PBMs were performed in cases where participants improved more than 10% in comparison with the previous trial.

Data Collection

Descriptive Data

Patient charts, surgical reports, and images taken during arthroscopic treatment were retrospectively reviewed to confirm diagnostic codes used as inclusion criteria and to describe arthroscopic treatment procedures as well as cartilage defects at the time of surgery. The alpha angle and center-edge angle were measured on all operated hips to describe cam morphology and confirm the absence of hip dysplasia. In patients who underwent unilateral HA, the alpha angle and center-edge angle were also measured on the nonoperated hip. Participants rated their activity levels (currently and before the onset of hip symptoms) according to the HSAS from 0 to 8, with 8 representing the highest activity level. The HSAS is considered a reliable and valid tool to determine activity levels in patients after HA for FAIS and was used to match activity levels of control participants.[27] The HSAS has not yet been officially translated into Swedish; therefore, a version used in previous research on a Swedish population was used.[34] We also assessed patients' current return-to-sports status on a continuum as recommended in a 2016 consensus statement.[1] Patients were asked to choose 1 of the following statements: (1) I don't participate in sporting activities ("no sport"), (2) I participate in sports/exercise but not in my previous sporting activity ("different sport"), (3) I participate in my previous sporting activity but not at the same performance level ("same sport, lower performance"), or (4) I participate in my previous sporting activity at the same or higher performance level ("same sport, same performance").

Subjective Hip Function

We used the Copenhagen Hip and Groin Outcome Score (HAGOS),[38,39] which is recommended for the evaluation of patients after HA for FAIS,[42] to assess current self-reported hip function. The HAGOS consists of 6 subscales, evaluating symptoms, pain, function during activities of daily living, function during sports and recreation, participation in physical activities, and hip-related quality of life, and it has been shown to be a valid and reliable tool in the active young to middle-aged.[39] Each HAGOS subscale score was computed and converted into a percentage of the total score, with 0% representing extreme amounts of hip and groin problems and 100% representing no hip and groin problems.

Objective Hip Function

ROM and Hip Muscle Strength. A single examiner (T.W.) assessed ROM and muscle strength of both hips according to routine clinical preoperative and follow-up protocols. The reliability of these test protocols was previously assessed on 19 patients with FAIS scheduled for HA (mean age, 33.6 ± 7.7 years; 16% [n = 3] female). Intraclass correlation coefficients (2-way random models [2.1]) for intratester reliability ranged from 0.72 to 0.90 (ROM) and 0.89 to 0.95 (strength). ROM measures were performed in the same order for all participants, while hip muscle strength measures were randomized (www.randomizer.org) according to starting leg, starting position (supine/prone), and starting direction (supine: flexion/abduction/adduction; prone: extension/internal rotation/external rotation) to avoid systematic effects of fatigue or potential pain provocation on individual measurements.

All ROM measures were performed in the supine position. For active hip flexion, participants were asked to maximally flex their hip with a flexed knee while keeping the nontested limb on the treatment table. For passive hip flexion, participants were asked to maximally pull their knee toward their head with both hands while keeping the nontested limb on the treatment table. No abduction or external rotation was permitted. Flexion measures were performed using a goniometer centered on the greater trochanter, distally aligned toward the lateral femoral condyle, and kept parallel to the treatment table. Passive internal and external rotation were measured in the supine position with the hip joint flexed to 90° in neutral by using a bubble inclinometer. The inclinometer was attached to the tibial tuberosity and the knee flexed to 90°. The examiner subsequently performed internal and external rotation until movement of the pelvis was observed.

For hip muscle function, isometric abduction, adduction, flexion, extension, internal rotation, and external rotation strength were measured with a handheld dynamometer (microFET2; Hogan Scientific) by the same examiner. A modified version of an established test protocol that was found to be valid and reliable was used.[41] The most prominent part of the malleolus was used as a reference point for the dynamometer attachment (5 cm proximal). Furthermore, the measurement sequence was modified to increase time efficiency. As opposed to performing 4 consecutive trials in the same direction, tested legs and directions were alternated for a total of 3 trials in each direction. The maximum generated force across trials (in N·m/kg) served as the test outcome.

Performance-Based Measures. The Y Balance Test (YBT), triple-hop test (THT), and Illinois agility test (IAT) were used to measure performance. The YBT is a modification of the Star Excursion Balance Test and is aimed to assess a combination of ROM, flexibility, balance, and strength.[12] In healthy participants, the YBT demonstrates good to excellent intrarater reliability[30] and is closely related to hip abduction strength[48] as well as hip ROM.[22] Information regarding its reliability and validity in populations with hip abnormalities is currently lacking. The participants' starting leg was randomized before testing. The YBT was performed barefoot and according to a previously described protocol.[30] The maximum reach distance of 3 trials, performed on each leg in the anterior, posteromedial, and posterolateral directions, was calculated relative to leg length (in percentages) and served as the test outcome.

Hop performance was measured by the medial and lateral THT, a reliable tool in patients with hip abnormalities that has been demonstrated to be able to distinguish between those with and without hip complaints.[21] The participants' starting leg was randomized before testing, and the length of the maximum triple jump (in cm) served as the test outcome.

The IAT combines maximal acceleration, deceleration, sudden change of direction, and nonlinear running. It was performed according to a previously described protocol, which has demonstrated good test-retest reliability and validity for general athletic ability to effectively change directions.[35] Patients in the HA group started the test on the same side they were operated on (for bilateral HA, the most recent surgical procedure) to force them to turn on the operated hip. The starting side for the first control participant was randomized (www.randomizer.org). Subsequently, every other control participant started the test on either the left or the right leg. All participants ran the course at a self-determined pace as a warm-up and to familiarize themselves with the requirements. Participants then performed 3 trials at maximum pace with 3 minutes' rest between trials, and the fastest time to complete the course (in seconds) served as the outcome.

Statistical Analysis

Data analysis was performed using SPSS (version 24; IBM). Group differences were analyzed using independent-samples t tests. Operated hips were compared with the dominant hips of control participants (the most recently treated hip was considered the tested leg for patients who had undergone bilateral HA). In the HA group, objective hip function was compared between the operated and nonoperated sides and analyzed through paired-samples t tests. Bilaterally treated patients were excluded from within-participant analysis. Standardized effect sizes (Cohen d, with accompanying 95% CIs) were computed. Effect sizes of 0.2 were considered small, 0.5 medium, and 0.8 large.[9]

The sample size was determined with the goal of being able to identify minimal detectable differences of 10% between groups for PBMs (YBT, medial THT, lateral THT, and IAT), corresponding to standardized effect sizes (Cohen d) between 0.7 and 0.9. With a significance level of .05 and 80% power, a sample of 20 to 34 participants per group was required. With 33 participants included in each group, the study had 80% power to detect an effect size of $d = 0.7$.

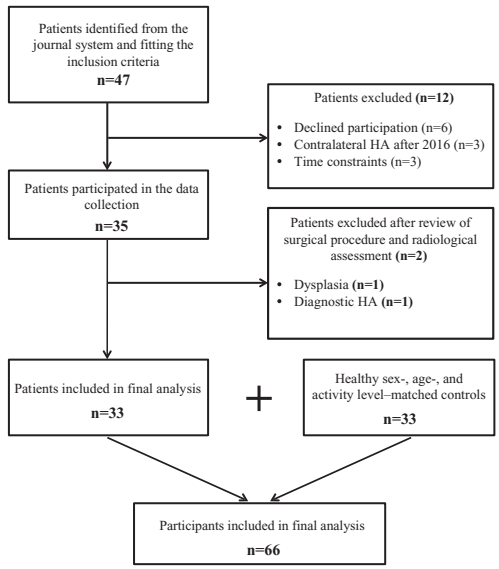


Figure 1. Participant flow into the study.

RESULTS

In total, 66 participants (33 in the HA group and 33 in the control group) were included in the study. The flow of participants into the study is summarized in Figure 1. Patient demographics, arthroscopic procedures, perioperative findings, and activity levels are presented in Table 1. More than one-third of all patients in the HA group (n = 12) were engaged in team sports (ice hockey [n = 7], basketball [n = 3], football [n = 1], bandy [n = 1]); the remaining patients engaged in individual sports (strength sports [n = 9], martial arts [n = 3]), endurance sports (running [n = 4], ice skating [n = 1]), and aesthetic sports (dance and gymnastics [n = 4]). Among the HA group, 70% (n = 23) had undergone unilateral HA (right hip: 64% [n = 21]; left hip: 36% [n = 12]), while 30% (n = 10) underwent subsequent bilateral HA. All patients had an alpha angle of >55°. Among patients who had undergone unilateral HA, 57% (n = 13) also had an alpha angle of >55° on the nonoperated side. None of the patients had dysplasia or radiological osteoarthritis (OA).

The HA group reported worse subjective hip function than the control group, with large and statistically significant effect sizes (Table 2 and Figure 2). We observed small effect sizes for the majority of objective outcomes, indicating generally reduced objective function in the HA group

TABLE 1
Participant Characteristics[a]

	HA (n = 33)	Control (n = 33)
Demographics		
Age, y	32.3 ± 9.4	31.1 ± 10.6
Weight, kg	79.8 ± 9.0	79.0 ± 12.6
Height, cm	179.3 ± 7.1	179.5 ± 7.5
Sex, n (%)		
Female	4 (12.1)	4 (12.1)
Male	29 (87.9)	29 (87.9)
Right leg dominance, n (%)	30 (90.9)	29 (87.9)
Time since surgery, mo	8.1 ± 2.6	—
Arthroscopic procedures, n (%)		
Cam resection	33 (100.0)	—
Combined cam and pincer	6 (18.2)	—
Labral trimming	31 (93.9)	—
Labral repair	1 (3.0)	—
Cartilage defects observed during surgery, n (%)		
Femoral cartilage defects	—	—
Acetabular cartilage defects	27 (81.8)	—
Outerbridge classification (acetabulum)[b]		
1	8 (24.2)	—
2	3 (9.1)	—
3	8 (24.2)	—
4	8 (24.2)	—
Activity level/sports participation		
Training hours per week	6.9 ± 4.0	7.1 ± 4.5
HSAS score, median (IQR)		
Before symptoms	6.5 (3.5-7.0)	—
Currently	4.5 (3.0-5.8)	5.0 (3.0-7.0)
Return-to-sports status, n (%)		
No sport	1 (3.0)	—
Different sport	11 (33.3)	—
Same sport, lower performance	15 (45.5)	—
Same sport, same performance	6 (18.2)	—
Satisfied with current activity level, n (%)	12 (36.4)	21 (63.6)[c]

[a]Data are reported as mean ± SD unless otherwise indicated. HA, hip arthroscopic surgery; HSAS, Hip Sports Activity Scale; IQR, interquartile range.
[b]Outerbridge grade: 1 = rough surface, chondral softening; 2 = irregular surface defects, <50% cartilage thickness; 3 = loss of >50% cartilage thickness; and 4 = cartilage loss, exposed bone.
[c]Thirty-two of 33 participants in the control group responded.

compared with the control group. The largest, and the only statistically significant, effect sizes were found for reduced hip ROM, hip flexion strength, and posteromedial reach of the YBT (Table 3 and Figure 3). Within the HA group, no consistent pattern of the observed small effect sizes favoring the function of one hip over the other emerged. Only for hip flexion ROM was there a moderate, statistically significant effect size indicating reduced mobility of the operated hip found (Table 4 and Figure 4).

DISCUSSION

This cross-sectional study compared patients 6 to 10 months after FAIS surgery with a healthy control group regarding subjective and objective hip function in addition to comparing the objective function of operated hips with nonoperated hips. In comparison with the control group, the HA group reported clinically relevant impairments in subjective hip function but generally presented with only minor impairments in objective function. The only marked impairments in objective function were found for measures of hip mobility as well as mobility-related performance measures. A side-to-side comparison in the HA group showed no clear pattern of differences between operated and nonoperated hips.

Patients in our study reported large and clinically relevant reductions in hip function across all HAGOS subscales,[39] with the largest impairments observed for hip-related sporting activity, physical activity, and quality of life. These results are in accordance with recent evidence documenting that patients who have undergone HA continue to have marked impairments in self-reported function, following the same domain-specific pattern of impairments as observed in our sample.[40] These marked reductions in self-reported function relating to the ability to function in sports, combined with the low rates of return to sporting performance seen in the current study and previous research,[15,49] suggest the presence of physical impairments that ought to be objectively measurable.

While a general pattern of reduced objective function for the HA group in comparison with the control group was observed in our sample, standardized effect sizes were small and statistically nonsignificant for the majority of outcomes, and their clinical relevance may therefore be debatable. Only differences in hip mobility, or more precisely, active and passive flexion as well as internal rotation, showed moderate to large effect sizes, indicating worse function in the HA group. FAIS is a motion-related clinical disorder associated with limited hip flexion and rotation ROM,[13] and FAIS surgery involves the correction of hip morphology and is therefore thought to remove anatomic constraints of joint kinematics and hence improve ROM.[14] Nevertheless, patients in this study had less hip mobility 6 to 10 months after HA compared with controls. Even though our data do not include a preintervention and postintervention comparison, our results indicate that patients with FAIS still had impaired hip ROM 6 to 10 months after arthroscopic treatment. In line with this finding, a 2016 systematic review suggested that hip ROM may in fact not improve after arthroscopic surgery.[11]

It is possible that these ROM impairments may also have affected patients' performance during other ROM-dependent measures of objective hip function. We found moderate effect sizes for reduced posteromedial reach of the YBT as well as for hip flexion strength, 2 tests requiring patients to perform tasks in joint ranges and motions known to be provocative in FAIS. During the YBT, the hip is forced into excessive flexion, internal rotation, and adduction, a combination of hip motions frequently used in the diagnostic process.[31] We measured hip flexion strength in the supine position, with the hip in 90° of flexion, consequently asking patients to produce flexion torque close to their end ROM.[8] Thus, impairments in ROM may

TABLE 2
Self-Reported Hip Function on the HAGOS[a]

HAGOS Subscale	HA (n = 33)	Control (n = 33)	Mean Difference (95% CI)	*P* Value[b]	Cohen *d* (95% CI)
Pain	86.1 ± 10.1	96.9 ± 6.3	–10.8 (–14.9 to –6.6)	<.001	–1.3 (–0.7 to –1.8)
Symptoms	74.9 ± 15.5	91.5 ± 10.1	–16.6 (–23.0 to –10.1)	<.001	–1.3 (–0.7 to –1.8)
Activities of daily living	91.4 ± 11.3	98.0 ± 6.0	–6.7 (–11.1 to –2.2)	.004	–0.7 (–0.2 to –1.2)
Sports and recreation	75.7 ± 17.7	95.3 ± 10.4	–19.6 (–26.8 to –12.4)	<.001	–1.4 (–0.8 to –1.9)
Physical activities	58.3 ± 33.5	95.8 ± 10.7	–37.5 (–49.9 to –25.1)	<.001	–1.5 (–1.0 to –2.1)
Quality of life	61.1 ± 22.0	96.2 ± 10.5	–35.2 (–43.7 to –26.6)	<.001	–2.1 (–1.4 to –2.6)

[a]Data are reported as mean ± SD unless otherwise indicated. There was a statistically significant between-group difference in all HAGOS subscores ($P < .05$ for all). HA, hip arthroscopic surgery; HAGOS, Copenhagen Hip and Groin Outcome Score.
[b]Independent-samples *t* test.

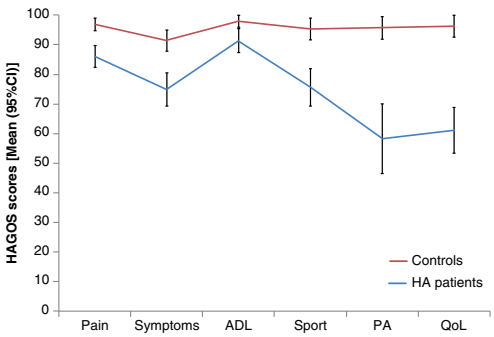


Figure 2. Between-group comparison of self-reported hip function. ADL, activities of daily living; HA, hip arthroscopic surgery; HAGOS, Copenhagen Hip and Groin Outcome Score; PA, physical activities; QoL, quality of life.

be associated with patients' functional performance 6 to 10 months after FAIS surgery.

It is possible that the impairments that we found are caused by residual surgical trauma. However, from a clinical perspective, this reduction in hip mobility is reminiscent of what is typically seen in patients with early manifestations of hip OA.[2-4] As reported in a 2018 meta-analysis, patients with FAIS present with biomechanical alterations in hip biomechanics such as reduced hip extension, and there is insufficient evidence for a change in these alterations after arthroscopic treatment.[20] Reduced hip extension during walking is also commonly seen in patients with early hip OA[46] and is thought to be a compensation strategy to unload the anterior hip joint,[24] the common location of chondrolabral abnormalities associated with FAIS.[36] It is important to note that HA for FAIS changes hip morphology, but much of the intra-articular abnormality remains. More than 80% of all patients in this study had acetabular cartilage defects during the time of arthroscopic surgery, which is a common finding in comparable cohorts.[5,8,25,36] These cartilage defects may represent early structural changes, present before the development of clinical OA.[37] According to current evidence, the presence and size of cam morphology are associated with an increased risk of developing OA in patients older than 45 years, but there are no available data to draw similar conclusions for patients of a younger age, such as those in our study.[44] Nevertheless, the high prevalence of chondropathy in our study and other studies on young to middle-aged adults with cam morphology undergoing HA,[5,8] as well as the observed pattern of physical impairments, suggests that patients with FAIS are clinically not clearly distinguishable from patients with early signs of hip OA. Therefore, it can also be argued that the objective impairments of the small effect sizes that we observed in patients could potentially be caused by their chondropathy, which are large enough to cause patients to perceive impairments in hip function but not yet linked to clinically measurable signs and symptoms.

When comparing the objective function of the operated hip to the nonoperated hip, we generally found only small and nonsignificant effect sizes, with no pattern favoring one hip over the other. The only measure showing a significant reduction of a medium effect size was passive hip flexion of the operated hip. In alignment with these results, Tijssen et al[43] found a limb symmetry index of >90% for PBMs, hip strength measures, and ROM measures except for internal rotation in their cohort of patients who underwent HA. It should be acknowledged that such intraindividual comparisons should be interpreted with caution and not taken as evidence for restored function, as the contralateral limb may have deconditioned after surgery. In patients after anterior cruciate ligament reconstruction, it has been shown that a side-to-side comparison of knee function 6 months after surgery overestimates knee function of the involved side.[47] Furthermore, patients with FAIS often present with bilateral morphological findings,[23] which potentially could affect performance in both hips. In our study, 57% of patients who had undergone unilateral HA had a contralateral alpha angle of >55°, highlighting the fact that the presence of cam morphology does not equal the presence of FAIS[13] and suggesting that other factors such as hip chondropathy may be responsible for the patients' complaints. This may explain why patients continued having impairments after the arthroscopic treatment of FAIS. A 2018 randomized controlled trial comparing the arthroscopic treatment of FAIS with supervised rehabilitation found clinically relevant improvements in both groups, with superior results for the

TABLE 3
Between-Group Comparison of Objective Outcomes[a]

	HA (n = 33)	Control (n = 33)	Mean Difference (95% CI)	*P* Value[b]
Range of motion, deg				
Active flexion	115.2 ± 7.3	120.5 ± 8.0	–5.3 (–9.1 to –1.5)	**.007**
Passive flexion	129.4 ± 8.2	138.3 ± 7.6	–8.9 (–12.8 to –5.1)	**<.001**
Passive internal rotation	27.6 ± 6.4	33.5 ± 9.1	–5.9 (–9.8 to –2.1)	**.003**
Passive external rotation	42.1 ± 8.6	46.1 ± 7.3	–3.9 (–7.8 to –0.1)	**.048**
Strength,[c] N·m/kg				
Abduction	2.26 ± 0.44	2.31 ± 0.25	–0.06 (–0.23 to 0.12)	.534
Adduction	2.28 ± 0.54	2.39 ± 0.40	–0.12 (–0.34 to 0.13)	.392
Flexion	1.49 ± 0.39	1.66 ± 0.27	–0.17 (–0.33 to –0.01)	**.043**
Extension	3.32 ± 0.66	3.45 ± 0.62	–0.14 (–0.45 to 0.18)	.396
External rotation	0.94 ± 0.23	0.99 ± 0.17	–0.05 (–0.15 to 0.05)	.317
Internal rotation	0.81 ± 0.21	0.89 ± 0.14	–0.07 (–0.16 to 0.02)	.102
Performance-based measures				
Medial THT,[d] cm	330.1 ± 120.3	354.1 ± 90.9	–23.9 (–77.6 to 28.8)	.35
Lateral THT,[d] cm	294.9 ± 101.3	329.3 ± 71.1	–34.4 (–77.6 to 8.9)	.117
YBT, % leg length				
Anterior	64.4 ± 6.8	66.2 ± 7.5	–1.8 (–5.4 to 1.7)	.303
Posteromedial	110.0 ± 11.6	115.7 ± 10.7	–5.7 (–11.2 to –0.2)	**.043**
Posterolateral	104.8 ± 14.3	109.7 ± 11.7	–4.9 (–11.3 to 1.5)	.132
IAT,[e] s	18.7 ± 2.7	18.1 ± 1.6	0.6 (–0.5 to 1.7)	.311

[a]Data are reported as mean ± SD unless otherwise indicated. Bolded *P* values indicate statistically significant between-group differences ($P < .05$). HA, hip arthroscopic surgery; IAT, Illinois agility test; THT, triple-hop test; YBT, Y Balance Test.
[b]Independent-samples *t* test.
[c]Lever arms for flexion and rotation measures were calculated according to Pietak et al.[29]
[d]One patient missing because of a sprained ankle during warm-up.
[e]Three patients in the HA group and 1 in the control group missing: ankle sprain during medial THT (n = 1) and declined participation for undisclosed reason (n = 3).

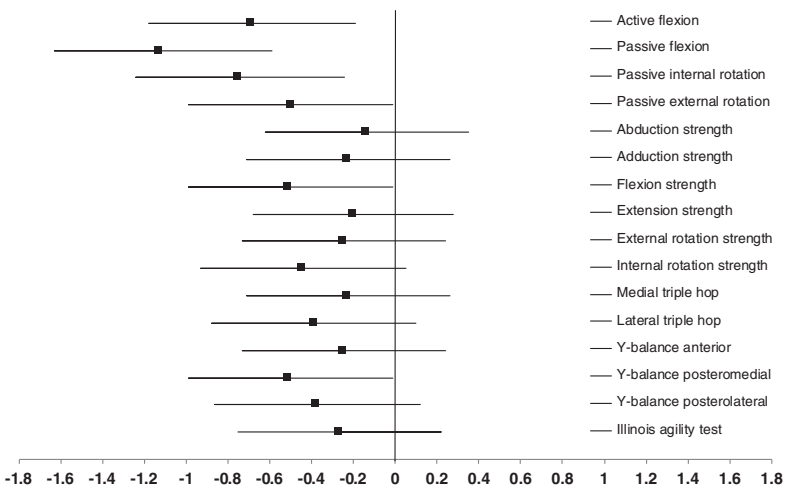


Figure 3. Standardized effect sizes (Cohen *d*) of group differences between patients in the hip arthroscopic surgery group and participants in the control group regarding objective outcomes. Negative effect sizes indicate inferior results in the hip arthroscopic surgery group.

TABLE 4
Within-Patient Comparison of Objective Outcomes in Unilaterally Operated Patients (n = 23)[a]

	Operated Hip	Nonoperated Hip	Mean Difference (95% CI)	*P* Value[b]
Range of motion, deg				
Active flexion	115.0 ± 7.4	115.0 ± 6.2	–0.0 (–1.8 to 1.8)	>.999
Passive flexion	128.9 ± 8.3	132.0 ± 6.9	–3.0 (–6.0 to –0.1)	**.045**
Passive internal rotation	27.6 ± 6.0	29.6 ± 7.1	–2.0 (–4.2 to 0.3)	.083
Passive external rotation	42.8 ± 8.1	40.0 ± 9.4	2.8 (–1.2 to 6.8)	.158
Strength,[c] N·m/kg				
Abduction	2.20 ± 0.46	2.20 ± 0.46	–0.01 (–0.11 to 0.10)	.904
Adduction	2.24 ± 0.59	2.18 ± 0.49	0.06 (–0.08 to 0.20)	.356
Flexion	1.45 ± 0.42	1.48 ± 0.39	–0.03 (–0.10 to 0.04)	.337
Extension	3.23 ± 0.69	3.17 ± 0.64	0.05 (–0.06 to 0.16)	.345
External rotation	0.92 ± 0.23	0.92 ± 0.22	0.01 (–0.03 to 0.04)	.719
Internal rotation	0.79 ± 0.21	0.81 ± 0.18	–0.01 (–0.06 to 0.03)	.464
Performance-based measures				
Medial THT,[d] cm	317.7 ± 127.0	313.3 ± 118.4	4.4 (–9.6 to 18.3)	.523
Lateral THT,[d] cm	285.0 ± 110.5	293.8 ± 108.5	–8.4 (–23.4 to 6.7)	.262
YBT, % leg length				
Anterior	63.3 ± 7.3	63.3 ± 7.2	–0.9 (–2.1 to 1.9)	.924
Posteromedial	108.7 ± 11.3	109.4 ± 12.9	–0.7 (–2.9 to 1.6)	.554
Posterolateral	102.7 ± 14.4	104.5 ± 14.5	–1.8 (–4.4 to 0.8)	.165

[a]Data are reported as mean ± SD unless otherwise indicated. Bolded *P* value indicates a statistically significant difference between the operated and nonoperated hips ($P < .05$). THT, triple-hop test; YBT, Y Balance Test.
[b]Paired-samples *t* test.
[c]Lever arms for flexion and rotation measures were calculated according to Pietak et al.[29]
[d]One patient missing because of a sprained ankle during warm-up.

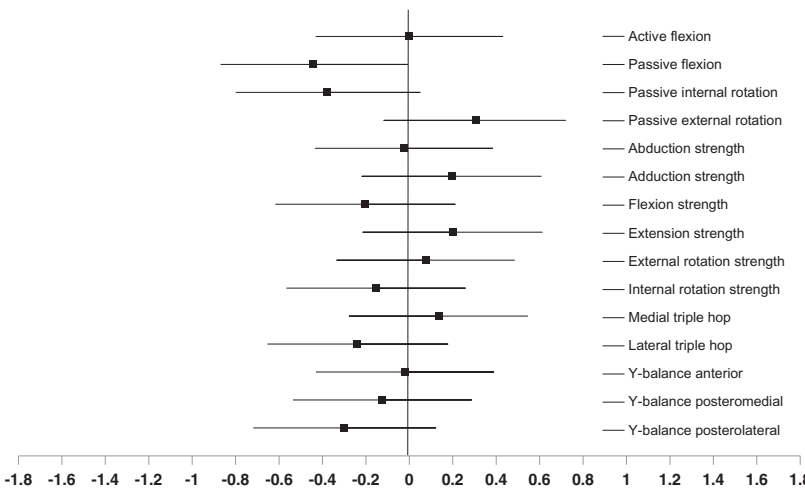


Figure 4. Standardized effect sizes (Cohen *d*) of differences between the operated and nonoperated hips of patients in the hip arthroscopic surgery group. Negative effect sizes indicate inferior results in the operated hip.

surgical treatment.[14] However, patients in that study also continued to have marked impairments in hip-related quality of life 1 year after the initiation of both treatments,[14] just as the patients in our study. As clinicians, we have to acknowledge that patients with FAIS are not likely to be free of intra-articular abnormalities after arthroscopic treatment, and their expectations may therefore need to be managed accordingly.

Although the results of our study demonstrated hip mobility impairments of approximately the same effect sizes as in previous research with a similar methodology,[18] other studies have found larger impairments in hip strength and performance measures.[7,17,18] A potential explanation for this is the choice of specific performance measures; however, the different results are rather likely attributable to differences in study samples. The previous studies[7,17,18] were based on patients who underwent HA for hip pain and a wide range of intra-articular abnormalities (~50% treated for FAIS),[16] while our sample underwent HA specifically for the treatment of FAIS (100% cam resections). Furthermore, the patients included in our study had preoperative activity levels corresponding to pivoting sports such as ice hockey and soccer (HSAS score: median, 6.5 [interquartile range, 3.5-7.0]) compared with the previous studies including patients who reported walking (corresponding to HSAS level 1) to be their primary physical activity.[7] Moreover, we chose to assess patients at 6 to 10 months after HA, when patients are usually discharged and may return to sports,[28,33,49] as opposed to 12 to 24 months after surgery as in previous studies.[7,17,18] Hence, it can be argued that our study is the first to compare objective physical function between a homogeneous group of athletic patients after FAIS surgery and a healthy control group.

There are some methodological considerations to be aware of when interpreting the results of this study. We aimed to match control participants to patients' presymptomatic HSAS levels as reported in data from preoperative visits. At the time of the measurements, participants in both groups reported their current activity levels. However, the patients' presymptomatic HSAS level differed by 1.5 points from the current HSAS level of control participants. This difference could likely be explained by potential discrepancies between our evaluations of control participants' HSAS level and participants' own self-evaluation during data collection. Hence, the lower HSAS level among control participants may have underestimated patients' impairments, as they were compared with a group not completely corresponding to their own preoperative level of activity.

The study sample consisted of a homogeneous group of physically active patients who underwent HA for the treatment of FAIS, and 74% of all potentially eligible patients participated. The results of this study should therefore be generalizable to the typical patient population with FAIS undergoing HA. As a cross-sectional study, our study describes patients' hip function during a specific period of 6 to 10 months after FAIS surgery. This provides a picture of subjective and objective hip function at this time but may not represent the end stage of recovery after HA, which may potentially be a much longer process.[19] It should be acknowledged that the follow-up time point in this study may thus not represent the end stage of recovery. Furthermore, it is unknown to what extent hip chondropathic changes may or may not deteriorate over time and which patients eventually will develop clinical OA. Future research should investigate the development of objective hip function, preferably using prospective study designs with repeated measurements.

CONCLUSION

Subjective hip function was substantially impaired in patients 6 to 10 months after HA for the treatment of FAIS in comparison with healthy controls. The HA group presented with comparable objective hip function for the majority of outcomes, with the exception of hip ROM and functional measures dependent on ROM. No consistent pattern of impairments was found in operated hips compared with nonoperated hips.

REFERENCES

1. Ardern CL, Glasgow P, Schneiders A, et al. 2016 consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. *Br J Sports Med*. 2016;50(14):853-864.
2. Arokoski MH, Arokoski JP, Haara M, et al. Hip muscle strength and muscle cross sectional area in men with and without hip osteoarthritis. *J Rheumatol*. 2002;29(10):2185-2195.
3. Arokoski MH, Haara M, Helminen HJ, Arokoski JP. Physical function in men with and without hip osteoarthritis. *Arch Phys Med Rehabil*. 2004;85(4):574-581.
4. Bastick AN, Damen J, Agricola R, Brouwer RW, Bindels PJ, Bierma-Zeinstra SM. Characteristics associated with joint replacement in early symptomatic knee or hip osteoarthritis: 6-year results from a nationwide prospective cohort study (CHECK). *Br J Gen Pract*. 2017;67(663):e724-e731.
5. Beck M, Kalhor M, Leunig M, Ganz R. Hip morphology influences the pattern of damage to the acetabular cartilage: femoroacetabular impingement as a cause of early osteoarthritis of the hip. *J Bone Joint Surg Br*. 2005;87(7):1012-1018.
6. Casartelli NC, Leunig M, Maffiuletti NA, Bizzini M. Return to sport after hip surgery for femoroacetabular impingement: a systematic review. *Br J Sports Med*. 2015;49(12):819-824.
7. Charlton PC, Bryant AL, Kemp JL, Clark RA, Crossley KM, Collins NJ. Single-leg squat performance is impaired 1 to 2 years after hip arthroscopy. *PM R*. 2016;8(4):321-330.
8. Clohisy JC, Knaus ER, Hunt DM, Lesher JM, Harris-Hayes M, Prather H. Clinical presentation of patients with symptomatic anterior hip impingement. *Clin Orthop Relat Res*. 2009;467(3):638-644.
9. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, New Jersey: Lawrence Erlbaum Associates; 1988.
10. Diamond LE, Dobson FL, Bennell KL, Wrigley TV, Hodges PW, Hinman RS. Physical impairments and activity limitations in people with femoroacetabular impingement: a systematic review. *Br J Sports Med*. 2015;49(4):230-242.
11. Freke MD, Kemp J, Svege I, Risberg MA, Semciw A, Crossley KM. Physical impairments in symptomatic femoroacetabular impingement: a systematic review of the evidence. *Br J Sports Med*. 2016;50(19):1180.
12. Fullam K, Caulfield B, Coughlan GF, Delahunt E. Kinematic analysis of selected reach directions of the Star Excursion Balance Test compared with the Y-Balance Test. *J Sport Rehabil*. 2014;23(1):27-35.
13. Griffin DR, Dickenson EJ, O'Donnell J, et al. The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement. *Br J Sports Med*. 2016;50(19):1169-1176.
14. Griffin DR, Dickenson EJ, Wall PDH, et al. Hip arthroscopy versus best conservative care for the treatment of femoroacetabular impingement syndrome (UK FASHIoN): a multicentre randomised controlled trial. *Lancet*. 2018;391(10136):2225-2235.
15. Ishoi L, Thorborg K, Kraemer O, Holmich P. Return to sport and performance after hip arthroscopy for femoroacetabular impingement in 18- to 30-year-old athletes: a cross-sectional cohort study of 189 athletes. *Am J Sports Med*. 2018;46(11):2578-2587.
16. Kemp JL, Makdissi M, Schache AG, Pritchard MG, Pollard TC, Crossley KM. Hip chondropathy at arthroscopy: prevalence and

relationship to labral pathology, femoroacetabular impingement and patient-reported outcomes. *Br J Sports Med*. 2014;48(14):1102-1107.
17. Kemp JL, Risberg MA, Schache AG, Makdissi M, Pritchard MG, Crossley KM. Patients with chondrolabral pathology have bilateral functional impairments 12 to 24 months after unilateral hip arthroscopy: a cross-sectional study. *J Orthop Sports Phys Ther*. 2016; 46(11):947-956.
18. Kemp JL, Schache AG, Makdissia M, Pritchard MG, Sims K, Crossley KM. Is hip range of motion and strength impaired in people with hip chondrolabral pathology? *J Musculoskelet Neuronal Interact*. 2014; 14(3):334-342.
19. Kierkegaard S, Langeskov-Christensen M, Lund B, et al. Pain, activities of daily living and sport function at different time points after hip arthroscopy in patients with femoroacetabular impingement: a systematic review with meta-analysis. *Br J Sports Med*. 2017;51(7): 572-579.
20. King MG, Lawrenson PR, Semciw AI, Middleton KJ, Crossley KM. Lower limb biomechanics in femoroacetabular impingement syndrome: a systematic review and meta-analysis. *Br J Sports Med*. 2018;52(9):566-580.
21. Kivlan BR, Carcia CR, Clemente FR, Phelps AL, Martin RL. Reliability and validity of functional performance tests in dancers with hip dysfunction. *Int J Sports Phys Ther*. 2013;8(4):360-369.
22. Kivlan BR, Martin RL. Functional performance testing of the hip in athletes: a systematic review for reliability and validity. *Int J Sports Phys Ther*. 2012;7(4):402-412.
23. Larson CM, Safran MR, Brcka DA, Vaughn ZD, Giveans MR, Stone RM. Predictors of clinically suspected intra-articular hip symptoms and prevalence of hip pathomorphologies presenting to sports medicine and hip preservation orthopaedic surgeons. *Arthroscopy*. 2018; 34(3):825-831.
24. Lewis CL, Sahrmann SA, Moran DW. Effect of hip angle on anterior hip joint force during gait. *Gait Posture*. 2010;32(4):603-607.
25. Lund B, Nielsen TG, Lind M. Cartilage status in FAI patients: results from the Danish Hip Arthroscopy Registry (DHAR). *SICOT J*. 2017;3:44.
26. Mannion AF, Impellizzeri FM, Naal FD, Leunig M. Fulfilment of patient-rated expectations predicts the outcome of surgery for femoroacetabular impingement. *Osteoarthritis Cartilage*. 2013;21(1):44-50.
27. Naal FD, Miozzari HH, Kelly BT, Magennis EM, Leunig M, Noetzli HP. The Hip Sports Activity Scale (HSAS) for patients with femoroacetabular impingement. *Hip Int*. 2013;23(2):204-211.
28. O'Connor M, Minkara AA, Westermann RW, Rosneck J, Lynch TS. Return to play after hip arthroscopy: a systematic review and meta-analysis. *Am J Sports Med*. 2018;46(11):2780-2788.
29. Pietak A, Ma S, Beck CW, Stringer MD. Fundamental ratios and logarithmic periodicity in human limb bones. *J Anat*. 2013;222(5):526-537.
30. Plisky PJ, Gorman PP, Butler RJ, Kiesel KB, Underwood FB, Elkins B. The reliability of an instrumented device for measuring components of the Star Excursion Balance Test. *N Am J Sports Phys Ther*. 2009;4(2): 92-99.
31. Reiman MP, Goode AP, Cook CE, Holmich P, Thorborg K. Diagnostic accuracy of clinical tests for the diagnosis of hip femoroacetabular impingement/labral tear: a systematic review with meta-analysis. *Br J Sports Med*. 2015;49(12):811.
32. Reiman MP, Peters S, Sylvain J, Hagymasi S, Ayeni OR. Prevalence and consistency in surgical outcome reporting for femoroacetabular impingement syndrome: a scoping review. *Arthroscopy*. 2018;34(4): 1319-1328.
33. Reiman MP, Peters S, Sylvain J, Hagymasi S, Mather RC, Goode AP. Femoroacetabular impingement surgery allows 74% of athletes to return to the same competitive level of sports participation but their level of performance remains unreported: a systematic review with meta-analysis. *Br J Sports Med*. 2018;52(15):972-981.
34. Sansone M, Ahlden M, Jonasson P, et al. Good results after hip arthroscopy for femoroacetabular impingement in top-level athletes. *Orthop J Sports Med*. 2015;3(2):2325967115569691.
35. Stewart PF, Turner AN, Miller SC. Reliability, factorial validity, and interrelationships of five commonly used change of direction speed tests. *Scand J Med Sci Sports*. 2014;24(3):500-506.
36. Suarez-Ahedo C, Gui C, Rabe SM, Chandrasekaran S, Lodhia P, Domb BG. Acetabular chondral lesions in hip arthroscopy: relationships between grade, topography, and demographics. *Am J Sports Med*. 2017;45(11):2501-2506.
37. Teichtahl AJ, Wang Y, Smith S, et al. Structural changes of hip osteoarthritis using magnetic resonance imaging. *Arthritis Res Ther*. 2014; 16(5):466.
38. Thomee R, Jonasson P, Thorborg K, et al. Cross-cultural adaptation to Swedish and validation of the Copenhagen Hip and Groin Outcome Score (HAGOS) for pain, symptoms and physical function in patients with hip and groin disability due to femoro-acetabular impingement. *Knee Surg Sports Traumatol Arthrosc*. 2014;22(4):835-842.
39. Thorborg K, Holmich P, Christensen R, Petersen J, Roos EM. The Copenhagen Hip and Groin Outcome Score (HAGOS): development and validation according to the COSMIN checklist. *Br J Sports Med*. 2011;45(6):478-491.
40. Thorborg K, Kraemer O, Madsen AD, Holmich P. Patient-reported outcomes within the first year after hip arthroscopy and rehabilitation for femoroacetabular impingement and/or labral injury: the difference between getting better and getting back to normal. *Am J Sports Med*. 2018;46(11):2607-2614.
41. Thorborg K, Petersen J, Magnusson SP, Holmich P. Clinical assessment of hip strength using a hand-held dynamometer is reliable. *Scand J Med Sci Sports*. 2010;20(3):493-501.
42. Thorborg K, Tijssen M, Habets B, et al. Patient-reported outcome (PRO) questionnaires for young to middle-aged adults with hip and groin disability: a systematic review of the clinimetric evidence. *Br J Sports Med*. 2015;49(12):812.
43. Tijssen M, van Cingel R, de Visser E, Nijhuis-van der Sanden M. A clinical observational study on patient-reported outcomes, hip functional performance and return to sports activities in hip arthroscopy patients. *Phys Ther Sport*. 2016;20:45-55.
44. van Klij P, Heerey J, Waarsing JH, Agricola R. The prevalence of cam and pincer morphology and its association with development of hip osteoarthritis. *J Orthop Sports Phys Ther*. 2018;48(4):230-238.
45. von Elm E, Altman DG, Egger M, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med*. 2007;4(10): e296.
46. Watelain E, Dujardin F, Babier F, Dubois D, Allard P. Pelvic and lower limb compensatory actions of subjects in an early stage of hip osteoarthritis. *Arch Phys Med Rehabil*. 2001;82(12):1705-1711.
47. Wellsandt E, Failla MJ, Snyder-Mackler L. Limb symmetry indexes can overestimate knee function after anterior cruciate ligament injury. *J Orthop Sports Phys Ther*. 2017;47(5):334-338.
48. Wilson BR, Robertson KE, Burnham JM, Yonz MC, Ireland ML, Noehren B. The relationship between hip strength and the Y-Balance Test. *J Sport Rehabil*. 2018;27(5):445-450.
49. Wörner T, Thorborg K, Stalman A, Webster KE, Momatz Olsson H, Eek F. High or low return to sport rates following hip arthroscopy is a matter of definition? *Br J Sports Med*. 2018;52(22):1475-1476.

Paper IV

Knee Surgery, Sports Traumatology, Arthroscopy
https://doi.org/10.1007/s00167-020-06157-4

HIP

Psychological readiness is related to return to sport following hip arthroscopy and can be assessed by the Hip-Return to Sport after Injury scale (Hip-RSI)

Tobias Wörner[1,2] · Kristian Thorborg[3] · Kate E. Webster[4] · Anders Stålman[2,5] · Frida Eek[1]

Received: 28 February 2020 / Accepted: 14 July 2020

Abstract

Purpose Psychological readiness may play an important role in the return to sport (RTS) process following hip arthroscopy (HA), but there are limited tools for the measurement of this construct. The aim of this study was to modify the Swedish version of the Anterior Cruciate Ligament-Return to Sport after Injury (ACL-RSI) scale for use in HA patients and evaluate its psychometric properties.

Methods Content validity of a modified version of the Swedish ACL-RSI (Hip-RSI) was evaluated through 127 HA patient responses and relevance ratings by an expert panel (35 patients, 9 surgeons, 11 physiotherapists). Items with low relevance were omitted. Construct validity was assessed by the association of Hip-RSI scores to hip-related sporting function (HAGOS sport) and quality of life (iHOT12). Hip-RSI scores were compared between patients who had not returned, or returned to sport participation, previous sport, and sport performance.

Results Item reduction resulted in a 6-item Hip-RSI scale with adequate content validity for the target population. Construct validity of the full and the item-reduced scale was demonstrated by correlation to HAGOS sport and iHOT12 (r 0.631–0.752). A gradient increase in Hip-RSI scores was found for patients returning to sport participation, previous sport, and sport performance.

Conclusion The short version of the Swedish Hip-RSI is a valid tool for the assessment of psychological readiness to RTS and can be recommended to be used in HA patients. Higher psychological readiness to RTS, assessed by the Hip-RSI, is found with increasing levels of return to sports following HA.

Level of evidence III.

Keywords Hip arthroscopy · Return to sports · Psychological readiness

Introduction

Athletes with femoroacetabular impingement syndrome (FAIS) often decide to undergo hip arthroscopy with the goal to return to sport (RTS) [12]. However, just half of all

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00167-020-06157-4) contains supplementary material, which is available to authorized users.

✉ Tobias Wörner
tobias.worner@med.lu.se

[1] Department of Health Sciences, Lund University, Box 157, 22100 Lund, Sweden

[2] Capio Artro Clinic, FIFA Medical Centre of Excellence, Sophiahemmet Hospital, Stockholm, Sweden

[3] Department of Orthopaedic Surgery, Sports Orthopaedic Research Center-Copenhagen (SORC-C), Copenhagen University Hospital, Amager-Hvidovre, Denmark

[4] School of Allied Health, Human Services and Sport, La Trobe University, Melbourne, Australia

[5] Department of Molecular Medicine and Surgery, Stockholm Sports Trauma Research Center, Karolinska Institutet, Stockholm, Sweden

Published online: 22 July 2020

athletes undergoing hip arthroscopy return to their pre-injury sport and one in five returns to previous performance levels [6, 22]. Recent research suggests that physical impairments alone cannot explain these low RTS rates, or the marked impairments in self-reported function observed in these patients [20].

Psychological factors related to autonomy (e.g., motivation) and competence (e.g., confidence, low fear) have been shown to play an important role in the RTS process [2] and should be taken into consideration during assessment of readiness to RTS [1]. In patients following anterior cruciate ligament reconstruction (ACLR), psychological readiness to RTS is strongly related to return to sport and participation at pre-injury levels of performance [19]. In the RTS process following HA, psychological readiness is also rated as one of the most influential factors by physiotherapists and surgeons in Scandinavia [21] and should, hence, be assessed.

After ACLR, psychological readiness to RTS can be assessed with the ACL-Return to Sport after Injury (ACL-RSI) scale [18], which has been translated and cross-culturally adapted into Swedish language [9]. A short, less knee-joint-specific version of the ACL-RSI (6 items) was developed to make it more accessible to other orthopaedic populations [17]. A recent study from Australia reported this short form to be a valid and reliable tool for patients following HA [8]. However, no HA patients were involved in the item reduction underlying the short form of the ACL-RSI [17] and content validity for the use on these patients can, hence, not be assumed. According to the COSMIN guidelines, content validity is the most important measurement property of a patient-reported outcome measure (PROM) [14] and should be determined when modifying a PROM for the use in a different patient population.

The purpose of this study was to validate the Hip-RSI, a modified version of the Swedish ACL-RSI, for the assessment of psychological readiness to RTS in patients following hip arthroscopy. It was aimed to adapt the full 12-item scale to the target population by performing an item reduction and to describe structural validity, internal consistency reliability, as well as content and construct validity of the full and the item-reduced scale. Associations between Hip-RSI scores and return to sport participation, previous sport, and sport performance following HA in patients with FAI syndrome further assessed the validity of the scale.

Materials and methods

The study was approved by the Ethics committee at Lund University (DNR 2016/1068, 2019/03225) and conformed to the provision of the Declaration of Helsinki. The Hip-RSI was constructed by modifying the Swedish version of the ACL-RSI [9] and by performing an item reduction based on (1) Hip-RSI scores of patients following HA and (2) relevance rating by an expert panel (consisting of patients, surgeons performing hip arthroscopy, and physiotherapists delivering rehabilitation). Psychometric properties of the full 12-item Hip-RSI as well as the item-reduced version were described, and construct validity assessed. Validation of the new scale was further made by comparing Hip-RSI scores between patients that had returned to various levels of sport participation.

Participants

Patients that underwent HA for the treatment of FAIS were identified via the patient register of a single surgical unit by searching for relevant diagnostic codes. Patients were included if they (a) were ≥ 18 years old; (b) had received HA for FAIS (Cam-, pincer-resection or combination) ≥ 3 months prior to data collection; (c) participated in sports/exercise prior to surgery [Hip Sports Activity Scale (HSAS) ≥ 1]; (d) did not have had any further surgery following their indexed HA. Figure 1 illustrates the patient flow into the study and Table 1 describes their characteristics. Hip-RSI scores of 127 patients (Table 1) were used for item reduction and assessment of psychometric properties.

The expert panel included 35 different HA patients [mean time since surgery 9 months (SD 5)], 9 HA surgeons [median years of experience with HA patients 7 (IQR 2.25–12.75); median number of HA patients treated 330 (IQR 75-950)] and 11 physiotherapists [median years of experience with HA patients: 9.5 (IQR 6–10); median number of HA patients treated 50 (IQR 43-88)]. The patients included in the expert panel were identified by the same method as described above for patients responding to the Hip-RSI, recruited during a later time period. Hip arthroscopy surgeons were recruited during the Swedish hip arthroscopy meeting, held in May 2019. Physiotherapists were identified from a previous study, investigating experiences with rehabilitation following hip arthroscopy [21].

Scale modification

The Swedish version of the ACL-RSI [9] was modified for the use on patients following hip arthroscopy by replacing the word “knee” by the word “hip” throughout the scale. The ACL-RSI is a 12-item scale, intended to measure three psychological responses to athletic injury thought to reflect the construct of psychological readiness: athlete’s emotions (5 items), confidence in performance (5 items), and risk appraisal (2 items). The scale has, however, previously shown to hold a unidimensional factorial structure and a mean score for all 12 items can be calculated [18]. Responses are given on a 0–100 visual analogue scale on which higher scores indicate higher psychological readiness.

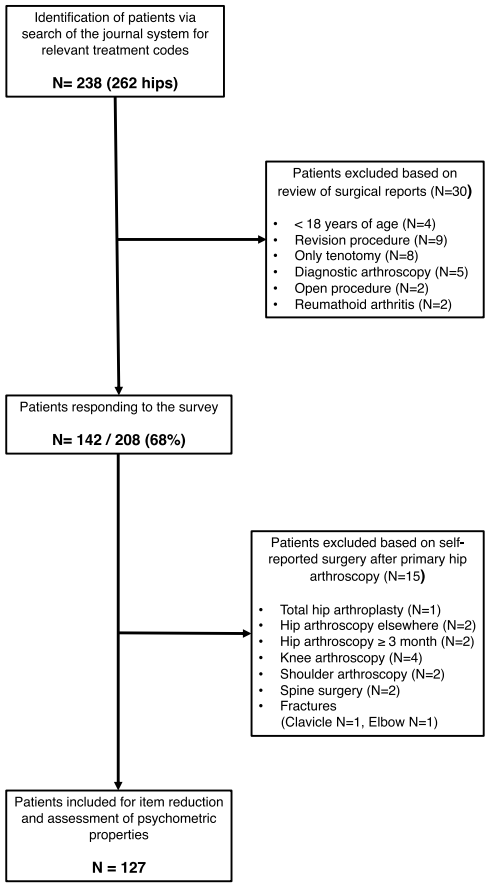


Fig. 1 Patient flow into the study

Data collection/procedure

In the first step, the 127 HA patients responded to an online survey, including the Hip-RSI (assessing current psychological readiness to RTS), current RTS status, as well as self-reported hip function. Patients provided their current RTS status according to consensus terminology [1] by answering whether they had (a) not returned to sport (did not participate in any sport or exercise) or returned to (b) participation (general participation in any sport or exercise), (c) sport (participation in previous sport or exercise on lower performance level than prior to hip symptoms), or (d) sport performance (participation in previous sport or exercise on same or higher performance level than prior to hip symptoms). Patients also reported their current hip function regarding quality of life and participation in sport, recreation, and physical activity by responding to two valid and reliable PROMS for hip arthroscopy patients—the International Hip Outcome Tool (iHOT12) and the sport subscale of the Copenhagen Hip and Groin Outcome Score (HAGOS) [7, 16]. Among other domains, the iHOT12 measures hip-related function in sports and recreational physical activities [5]. The HAGOS sport subscale measures a construct directly related to sport participation [16].

Table 1 Patient characteristics ($N = 127$)

Age in years [mean (SD); range]	34.3 (10.13); 17–60
Gender [*n* (%)]	
Females	31 (24.4)
Males	96 (75.6)
HSAS pre-op ($N = 126$)	
Mean (SD)	5.5 (1.9)
Median (IQR)	5 (4–7)
Time since op (months)	
[Mean (SD); range]	19.4 (10.4); 3–39
[Median (IQR)]	18.3 (10.8–25.9)
Arthroscopic procedure ($N = 125$)	
Cam resection [*n* (%)]	109 (87.2)
Cam and pincer resection [*n* (%)]	16 (12.8)

HSAS 4 includes participation in recreational and competitive sports such as football, ice hockey, indoor sports (basketball, handball, and floorball), martial arts, and alpine sports

The expert panel received a public link to an anonymous online survey in which they were asked to rate the relevance of the individual Hip-RSI items. The expert panel was asked to rate the relevance of all 12 Hip-RSI items for the assessment of psychological readiness to RTS in hip arthroscopy patients with regard to the domain which they are supposed to measure. Rating was performed on a 4-point Likert scale (1 not relevant; 2 somewhat relevant; 3 quite relevant; 4 highly relevant). Furthermore, the expert panel was asked in an open question to indicate if they thought the scale was lacking items concerning aspects of specific relevance for HA patients.

Analytical procedure

Data management

The Hip-RSI score was calculated as mean of the included items (scale 0–100, with 100 representing highest psychological readiness). The HAGOS subscale sport were computed as a score representing the percentages of the maximal score (100), with zero representing extreme amounts of hip and groin problems and 100 representing no hip and groin problems. iHOT12 scores are computed as the mean of the

12 items, on a scale from 0 to 100 with 0 representing the worst possible hip function and 100 representing the best possible hip function.

Scale reduction

The decision to retain or omit individual items was based on a combination of the patient responses and expert ratings. Means with standard deviations (SD) and medians with interquartile range (IQR) were computed for each item. The proportion of responses that were the minimum and maximum score (0 and 100) is reported for each item. A floor or ceiling effect is considered present if > 20% of participants score the minimum or maximum value. Within each domain, items were retained if at least two of the following criteria were fulfilled: (a) patients' responses demonstrated central tendencies close to the center of possible range and large spread (in relation to other items in the three respective domains), and/or the item demonstrated high relevance based on (b) expert rating (mean relevance score exceeding two-thirds of maximum score, corresponding to ≥ 2.7 and/or (c) at least 67% of all experts rated them to be relevant) [10, 11, 17].

Psychometric properties

Psychometric properties were explored and described for the full as well as for the item-reduced scale. Structural validity was assessed by confirmative factor analysis (with varimax rotation) to determine whether the items held the same factorial structure as the original ACL-RSI. Cronbach's alpha was computed as a measure of internal consistency reliability. Floor and ceiling effects were evaluated for the individual items. Construct validity was assessed by relating HIP-RSI scores of HA patients to hip-related quality of life (iHOT12) and sporting function (HAGOS sport). Since the data contained no extreme outliers affecting the results, the strength of correlations between Hip-RSI scores and iHOT12 as well as HAGOS sport were estimated by Pearson correlation coefficients and corresponding 95% confidence intervals (CI). We expected correlations to be larger than 0.5 between these instruments and the Hip-RSI. Since iHOT12 is measuring more than just sporting-related function, we expected correlation between Hip-RSI and the HAGOS subscale sport to be stronger.

Association with RTS

Differences in Hip-RSI between patients that have reached different levels of RTS was explored by analysis of variance (ANOVA), with post hoc pairwise group comparisons as well as test for linearity. Significance level was set to $P \leq 0.05$.

Results

Item relevance

Half of the items were rated as relevant by between 69.1 and 90.9% of the expert panel. Patient responses for those items had a mean score close to the middle of the scale. Individual item scores as well as relevance ratings are presented in Table 2. Based on patients' responses and expert ratings of item relevance, six items were omitted from the 12-item scale due to low face validity for the assessment of patients following hip arthroscopy. Three members of the expert panel commented that the scale is lacking items related to fear of pain during sport participation, and concerns about long-term consequences for hip health with sport participation.

Psychometric properties

Results of principal component factor analysis showed a single underlying factor accounting for 67.7% of the total variance (eigenvalue 8.1) for the full 12-item scale and 67.7% of the total variance (eigenvalue 4.1) for the 6-item scale. Cronbach's alpha for the full 12-item scale was 0.96 and 0.90 for the 6-item scale. No floor or ceiling effects were observed for either the full or item-reduced scale (full scale: minimum score 1.4%, maximum score 1.4%; item-reduced scale min score 1.4%, max score 4.9%). In accordance with a priori hypotheses, correlations between the full as well as the short form of the Hip-RSI and HAGOS sport and iHOT12 were larger than 0.5 (Table 3 and Fig. 2).

Association with RTS

Higher Hip-RSI scores were found with increasing level of RTS for both the 12-item scale as well as the 6-item scale (Fig. 3), with a statistically significant linear trend ($P < 0.001$). Hip-RSI scores of RTS groups differed significantly from each other except for patients who reported return to a different sport and patients who reported return to the same sport at a lower performance levels (Table 4).

Table 2 Patient scores and expert relevance score for individual Hip-RSI items

Scale item	Patient scores				Relevance rating	
	Mean (SD)	Median (IQR)	Floor effect (%)	Ceiling effect (%)	Mean (SD)	Rated relevant (%)
Emotions						
1. *Are you nervous about playing your sport?*	61.6 (30.9)	*65.5* (*33.8–93.9*)	3	11	2.8 (1.1)	*58.2*
2. **Do you find it frustrating to have to consider your hip with respect to your sport?**	45.9 (37.0)	41.0 (7.3–85.8)	12	10	3.3 (1.0)	80.0
3. **Do you feel relaxed about playing your sport?**	62.3 (31.8)	*67.5* (*33.8–93.0*)	4	14	3.0 (0.8)	70.9
4. *Are you fearful of reinjuring your hip by playing your sport?*	59.1 (32.1)	*67.0* (*31.5–87.5*)	4	13	3.1 (0.9)	*56.4*
5. *Are you afraid of accidentally injuring your hip by playing your sport?*	66.1 (31.8)	*77.0* (*36.0–95.8*)	2	17	*2.5* (*1.0*)	*45.5*
Confidence in performance						
6. *Are you confident that your hip will not give way by playing your sport?*	59.7 (33.9)	*61.0* (*30.0–93.0*)	6	12	2.7 (0.9)	*63.6*
7. **Are you confident that you could play your sport without concern for your hip?**	49.3 (34.7)	48.0 (18.5–85.5)	11	6	3.1 (0.9)	76.4
8. *Are your confident about your hip holding up under pressure?*	60.3 (31.3)	*64.0* (*34.0–90.0*)	4	10	2.7 (0.9)	*53.7*
9. **Are you confident that you can perform at your previous level of sport participation?**	52.7 (38.8)	52.0 (13.8–97.0)	11	20	3.4 (7.1)	90.9
10. **Are you confident about your ability to perform well at your sport?**	54.1 (35.0)	50.0 (20.0–93.5)	6	13	3.1 (0.8)	74.1
Risk appraisal						
11. **Do you think you are likely to reinjure your hip by participating in your sport?**	*62.3 (31.6)*	*71.0* (*38.0–91.0*)	3	15	2.8 (1.1)	69.1
12. *Do thoughts of having to go through surgery and rehabilitation again prevent you from playing your sport?*	*75.7 (30.1)*	*91.0* (*53.0–100*)	2	35	*2.5* (*1.2*)	*54.5*

Range of answer scores was 0–100 for all items. Final items with adequate relevance are marked in **BOLD**. Items to be omitted are marked in *ITALICS*. Respective patient scores as well as relevance rating underlying the decision to omit an item marked in *ITALICS* and underlined

Table 3 Correlations [Pearson (95% CI)] between the Hip-RSI hip function

	12-Item scale	6-Item scale
HAGOS sport	0.69 (0.66–0.96)	0.63 (0.56–0.87)
iHOT-12	0.75 (0.78–1.07)	0.73 (0.72–1.01)

HAGOS Hip and Groin Outcome Score, *iHOT-12* International Hip Outcome Tool

Discussion

In this study, psychometric properties of the Swedish ACL-RSI, modified for the use in patients undergoing hip arthroscopy, were assessed and an item-reduction based on patient responses and expert rating was performed. The item-reduced, 6-item version of the Hip-RSI was found to be an internally consistent, unidimensional, and valid tool for the assessment of psychological readiness to RTS after arthroscopic treatment of FAI syndrome in physically active patients. Psychological readiness to RTS, assessed by the Hip-RSI, was gradually greater as patients had returned to participation, previous sports, and performance.

This is the first study investigating content validity of a hip-modified ACL-RSI version for the assessment of psychological readiness to RTS in patients following HA. Arthroscopic treatment of ACL ruptures aims to restore knee stability, but athletes frequently decide not to RTS, because they experience recurrent knee instability and fear reinjury [15]. Arthroscopic treatment of FAI syndrome, on the other hand, aims to reshape hip morphology to reduce mechanical impingement [4], and the main reason not to RTS appears to be lingering pain [6]. These fundamental differences are reflected in the item-reduction process. The short form of the ACL-RSI [17] has previously been tested on HA patients [8]. However, our scale modification and item-reduction process was based on responses and opinions from the target population of HA patients. The resulting short form of the Hip-RSI, hence, differs from

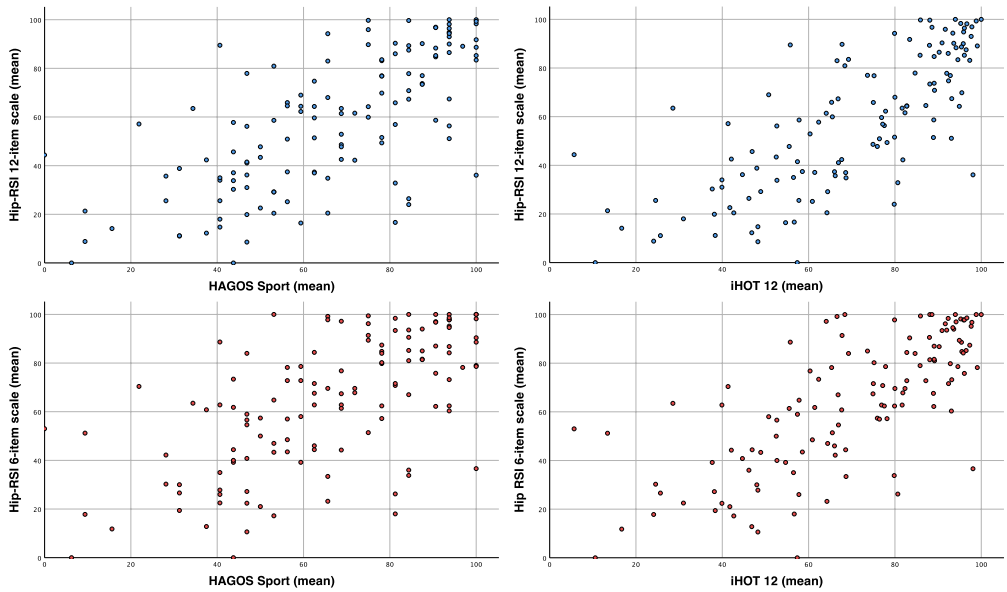


Fig. 2 Correlations between 12-item Hip-RSI (top row/blue) as well as 6-item Hip-RSI (bottom row/red) and HAGOS sport (left) as well as i-Hot 12 (right)

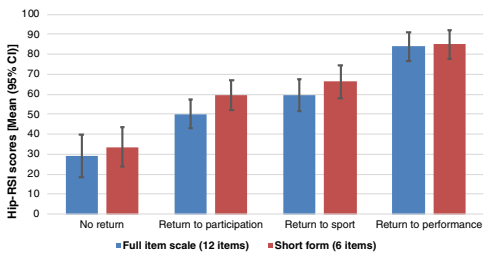


Fig. 3 Patients' ($N = 127$) Hip-RSI scores according to RTS-level

the short form of the ACL-RSI. In direct comparison of the two versions, the Hip-RSI presented in this study does focus less on joint instability and fear of reinjury while putting more emphasize on confidence in performance. The HA patient population-based item-reduction process resulted in a 6-item Hip-RSI scale with adequate content validity for the use in HA patients. Performance and injury-related fears, anxiety, and confidence are reported to be associated with RTS [3] and these aspects are covered by the items included in the 6-item Hip-RSI version.

The Hip-RSI was found to be correlated to self-reported hip and groin function in the direction and magnitude specified in the a priori hypothesis regarding construct validity. While HAGOS sport measures specific hip-related sporting function, iHOT12 assesses hip-related quality of life [5, 16]. Contrary to our expectations, we did not find stronger correlations between the Hip-RSI and HAGOS sport compared to iHOT12, which suggests that psychological readiness to RTS is affected by more than just joint-specific physical recovery. In ACL patients, thigh muscle strength and jump testing has been found to have little-to-no association to psychological readiness to RTS [13], further pointing towards the need to assess and treat both physical and psychological recovery following surgery. In this study, a gradient increase in Hip-RSI scores was found with increased level of RTS, further strengthening the construct validity of the scale. The Hip-RSI showed discriminant validity by yielding different scores for patients that made no return, returned to previous sports, and returned to sport performance. Hip-RSI scores of patients changing sports and returning to the previous sport on lower performance levels did not different significantly, further highlighting the importance of items assessing performance-related fears, anxiety, and confidence, which have shown to be associated with RTS [3] and rated to be highly relevant by our expert group. Hence, results of this study

Table 4 Differences in Hip-RSI groups between RTS groups

Level of return to sports Pairwise comparison	Hip-RSI scores			
	12-Item scale		6-Item scale	
	Mean diff. (95% CI)	*P*	Mean diff. (95% CI)	*P*
Same sport: same perf.				
No sport/exercise	54.8 (35.3 to 74.2)	< 0.001	51.4 (31.8 to 71.1)	< 0.001
Different sport/exercise	34.0 (19.8 to 48.1)	< 0.001	25.5 (11.2 to 39.8)	< 0.001
Same sport: lower perf.	24.5 (9.5 to 39.6)	< 0.001	18.6 (3.4 to 33.8)	0.001
Same sport: lower perf.				
No sport/exercise	30.2 (11.6 to 48.8)	< 0.001	32.9 (14.1 to 51.6)	< 0.001
Different sport/exercise	9.4 (− 3.5 to 22.4)	n.s	6.9 (− 6.2 to 20.0)	n.s
Different sport/exercise				
No sport/exercise	20.8 (2.9 to 38.7)	0.016	25.9 (7.9 to 44.0)	0.002

Hip-RSI Hip return to sport following injury, *per.* performance

further highlight the relationship between psychological readiness to RTS and actual level of return to sports, but, most importantly, present a valid tool for the assessment of psychological readiness in patients following HA for FAI syndrome.

There are a number of methodological considerations to make when interpreting the current study. The current study investigated psychometric properties of a hip-modified version of the Swedish ACL-RSI version [9] and it cannot be assumed that results transfer directly to the English version. The sample of this study consisted of a homogeneous group of patients in terms of surgical indication and arthroscopic treatment. All participants underwent HA for FAI syndrome and results of this study can, hence, be generalized to this group of patients. Patients answered the Hip-RSI at various follow-up times, ranging from 3 to 39 months following surgery. Psychological readiness may differ for patients at different follow-up times. The survey is intended to be applicable at different time points during the rehabilitation period. The potential spread in Hip-RSI results was, hence, warranted by our primary aim to investigate its psychometric properties not only at a specific time point but during the longer period between surgery and RTP. Future prospective studies should investigate the trajectory of psychological readiness to RTS after HA for FAI syndrome, preferably alongside collecting data about the recovery of physical function as well as return to sport. The ACL-RSI is intended to measure psychological readiness to return to sports in ACL patients. The stringent item-reduction process applied in this study can be expected to have excluded items with low relevance for HA patients. Conversely, there might be aspects of psychological readiness important to HA patients that are not included in the original ACL-RSI and, hence, neither in the Hip-RSI. Future studies should consider adding items assessing aspects where highlighted by experts in this study, such as fear of pain during sport participation and concerns about future hip health upon RTS. According to the COSMIN guidelines, content validity, which is assessed in this study, is the most important measurement property of a patient-reported outcome [14]. Following the COSMIN guidelines, content validity of the Hip-RSI was assessed by involving patients and other relevant medical professionals that rated relevance of the different items. Due to the cross-sectional design of this study, additional psychometric properties such as test–retest reliability, responsiveness, and measurement error of the Hip-RSI were not described in this study. The study by Jones et al. [8] reported that the short ACL-RSI showed excellent test–retest reliability and responsiveness to change in HA patients. It can be expected that the short form of the Hip-RSI, containing only items with relevance for HA patients, will demonstrate similar or even better test–retest reliability and responsiveness to change. However, these psychometric properties of the short 6-item Hip-RSI have to be evaluated prospectively in future studies.

Conclusion

The hip-modified and item-reduced version of the Swedish ACL-RSI (Hip-RSI) demonstrated adequate validity for the assessment of psychological readiness for return to sport in HA patients. The Hip-RSI was able to discriminate between patients that returned to their previous sports and sport performance, highlighting the potential impact of psychological aspects in the RTS process and, hence, the need to assess and address psychological readiness to RTS in this group of patients.

Acknowledgements Open access funding provided by Lund University. The authors would like to thank all patients and health care professionals that contributed to the study.

Author contributions All authors contributed to the conception and design of the study (TW, KT, KW, AS, and FE). Data were collected by TW and analyzed by TW and FE. TW wrote the manuscript which was revised, read, and approved by all authors.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Funding No external funding was received for the performance of this study.

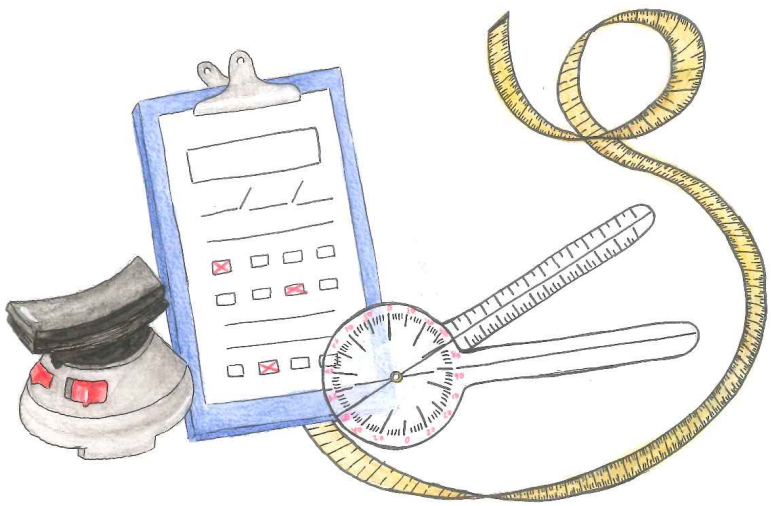
Ethical approval The study was approved by the Ethics Committee at Lund University (Dnr 2016/1068, 2019-03225).

Informed consent Patients received written information about the study alongside a link to the web survey, including the patient-reported outcomes used in this study. Participation was voluntary and informed consent was given by responding to the survey. The expert panel (patients and health care professionals) involved in the relevance rating of Hip-RSI items did not provide personal information or any sensitive data. Information regarding the study was provided in the web survey and informed consent given by responding to the survey.

References

1. Ardern CL, Glasgow P, Schneiders A, Witvrouw E, Clarsen B, Cools A, Gojanovic B, Griffin S, Khan KM, Moksnes H, Mutch SA, Phillips N, Reurink G, Sadler R, Silbernagel KG, Thorborg K, Wangensteen A, Wilk KE, Bizzini M (2016) 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. Br J Sports Med 50(14):853–864
2. Ardern CL, Taylor NF, Feller JA, Webster KE (2013) A systematic review of the psychological factors associated with returning to sport following injury. Br J Sports Med 47(17):1120–1126
3. Forsdyke D, Smith A, Jones M, Gledhill A (2016) Psychosocial factors associated with outcomes of sports injury rehabilitation in competitive athletes: a mixed studies systematic review. Br J Sports Med 50(9):537–544
4. Griffin DR, Dickenson EJ, Wall PDH, Achana F, Donovan JL, Griffin J, Hobson R, Hutchinson CE, Jepson M, Parsons NR, Petrou S, Realpe A, Smith J, Foster NE, FASHIoN Study Group (2018) Hip arthroscopy versus best conservative care for the treatment of femoroacetabular impingement syndrome (UK FASHIoN): a multicentre randomised controlled trial. Lancet 391(10136):2225–2235
5. Griffin DR, Parsons N, Mohtadi NG, Safran MR, Multicenter Arthroscopy of the Hip Outcomes Research Network (2012) A short version of the International Hip Outcome Tool (iHOT-12) for use in routine clinical practice. Arthroscopy 28(5):611–616 **(quiz 616–618)**
6. Ishoi L, Thorborg K, Kraemer O, Holmich P (2018) Return to sport and performance after hip arthroscopy for femoroacetabular impingement in 18- to 30-year-old athletes: a cross-sectional cohort study of 189 athletes. Am J Sports Med 46(11):2578–2587
7. Jonasson P, Baranto A, Karlsson J, Sward L, Sansone M, Thomee C, Ahlden M, Thomee R (2014) A standardised outcome measure of pain, symptoms and physical function in patients with hip and groin disability due to femoro-acetabular impingement: cross-cultural adaptation and validation of the international Hip Outcome Tool (iHOT12) in Swedish. Knee Surg Sports Traumatol Arthrosc 22(4):826–834
8. Jones DM, Webster KE, Crossley KM, Ackerman IN, Hart HF, Singh PJ, Pritchard MG, Gamboa G, Kemp JL (2020) Psychometric properties of the Hip-Return to Sport After Injury Scale (Short Form) for evaluating psychological readiness to return to sports after arthroscopic hip surgery. Am J Sports Med 48(2):376–384
9. Kvist J, Osterberg A, Gauffin H, Tagesson S, Webster K, Ardern C (2013) Translation and measurement properties of the Swedish version of ACL-Return to Sports after Injury questionnaire. Scand J Med Sci Sports 23(5):568–575
10. Lyman S, Lee YY, Franklin PD, Li W, Cross MB, Padgett DE (2016) Validation of the KOOS, JR: a short-form knee arthroplasty outcomes survey. Clin Orthop Relat Res 474(6):1461–1471. https://doi.org/10.1007/s11999-016-4719-1
11. Lyman S, Lee YY, Franklin PD, Li W, Mayman DJ, Padgett DE (2016) Validation of the HOOS, JR: a short-form hip replacement survey. Clin Orthop 474(6):1472–1482
12. Mannion AF, Impellizzeri FM, Naal FD, Leunig M (2013) Fulfilment of patient-rated expectations predicts the outcome of surgery for femoroacetabular impingement. Osteoarthr Cartil 21(1):44–50
13. O'Connor RF, King E, Richter C, Webster KE, Falvey EC (2020) No relationship between strength and power scores and Anterior Cruciate Ligament Return to Sport After Injury scale 9 months after anterior cruciate ligament reconstruction. Am J Sports Med 48(1):78–84. https://doi.org/10.1177/0363546519887952
14. Prinsen CAC, Mokkink LB, Bouter LM, Alonso J, Patrick DL, de Vet HCW, Terwee CB (2018) COSMIN guideline for systematic reviews of patient-reported outcome measures. Qual Life Res 27(5):1147–1157
15. Sandon A, Engstrom B, Forssblad M (2020) High risk of further anterior cruciate ligament injury in a 10-year follow-up study of anterior cruciate ligament-reconstructed soccer players in the Swedish National Knee Ligament Registry. Arthroscopy 36(1):189–195
16. Thorborg K, Holmich P, Christensen R, Petersen J, Roos EM (2011) The Copenhagen Hip and Groin Outcome Score (HAGOS): development and validation according to the COSMIN checklist. Br J Sports Med 45(6):478–491
17. Webster KE, Feller JA (2018) Development and validation of a short version of the Anterior Cruciate Ligament Return to Sport After Injury (ACL-RSI) scale. Orthop Sports Med 6(4):2325967118763763. https://doi.org/10.1177/2325967118763763
18. Webster KE, Feller JA, Lambros C (2008) Development and preliminary validation of a scale to measure the psychological impact of returning to sport following anterior cruciate ligament reconstruction surgery. Phys Ther Sport 9(1):9–15
19. Webster KE, McPherson AL, Hewett TE, Feller JA (2019) Factors associated with a return to preinjury level of sport performance after anterior cruciate ligament reconstruction surgery. Am J Sports Med 47(11):2557–2562
20. Worner T, Nilsson J, Thorborg K, Granlund V, Stalman A, Eek F (2019) Hip function 6 to 10 months after arthroscopic surgery: a

cross-sectional comparison of subjective and objective hip function, including performance-based measures, in patients versus controls. Orthop Sports Med 7(6):2325967119844821. https://doi.org/10.1177/2325967119844821
21. Worner T, Thorborg K, Moksnes H, Eek F (2018) Similar views on rehabilitation following hip arthroscopy among physiotherapists and surgeons in Scandinavia: a specialized care survey. Knee Surg Sports Traumatol Arthrosc 26(8):2519–2526
22. Worner T, Thorborg K, Stalman A, Webster KE, Momatz Olsson H, Eek F (2018) High or low return to sport rates following hip arthroscopy is a matter of definition? Br J Sports Med 52(22):1475–1476



Printed by Media-Tryck, Lund 2021 NORDIC SWAN ECOLABEL 3041 0903

LUND UNIVERSITY

FACULTY OF MEDICINE

Department of Health Sciences

Lund University, Faculty of Medicine
Doctoral Dissertation Series 2021:88
ISBN 978-91-8021-095-9
ISSN 1652-8220