NORWEGIAN SCHOOL OF SPORT SCIENCES

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Physical therapy-led rehabilitation of patients with Femoroacetabular Impingement (FAI) and/or labral tears

A systematic review and prospective case series

Master thesis in Sports Sciences
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Norwegian School of Sport Sciences, 2017

Abstract

Study design: Systematic review and prospective case series.

Objective: To identify and discuss the structure, content and feasibility of the physical therapy-led rehabilitation for patients with Femoroacetabular impingement (FAI) and/or labral tears in the current literature and in the ongoing HIPARTI-study (clinicaltrail.gov #NCT02692807).

Background: No high-quality studies have yet evaluated the effect of a physical therapy-led rehabilitation program for the increasingly reported FAI population. As an initial step, the content and feasibility of the physical therapy-led rehabilitation programs currently available, should be evaluated.

Method: A systematic search of literature was conducted to identify physical therapy-led rehabilitation programs for patients with FAI and/or labral tears. The quality of the included studies was assessed using a modified Coleman Methodological Score (CMS). The structure, content and feasibility of the rehabilitation programs were summarized in a systematic review. The rehabilitation of three cases following the HIPARTI rehabilitation program were collected in training diaries. Adverse events, compliance, progression of exercise and clinical change were evaluated for each case in a prospective case series. The findings from both studies were included in a thorough discussion.

Results: Eight studies were included in the systematic review. The studies included rehabilitation programs with similar structure and content as the rehabilitation program used in HIPARTI. The included studies disclosed limited data on feasibility and were of low methodological quality, with an average score of 54 on the modified CMS. The rehabilitation program used in HIPARTI was feasible in one case, with adverse events, limited progression of exercise and a lack of clinical change present two cases.

Conclusion: There are limited evidence on content and feasibility of physical therapy-led rehabilitation of patients with FAI and/or labral tears. The evidence that does exists are of low methodical quality and disclose no data on the feasibility of the rehabilitation programs applied. A 12-week post-operative rehabilitation program for patients with FAI and/or labral tears was not found feasible in cases where hip-related adverse events occurred. Larger feasibility studies of higher methodical quality should be conducted on physical therapy-led rehabilitation of patients with FAI and/or labral tears.

Key words: Systematic review, case series, FAI, labral tears, physical therapy-led rehabilitation.

Acknowledgment

First, I would like to thank my thesis adviser May Arna Risberg PT, PhD. Professor Department of Sport Medicine, Norwegian School Sport Sciences. Thanks for inviting me to join the HIPARTI project and thanks for all the useful comments, remarks and engagement along the way.

Secondly, I would like to thank the participants and physical therapists involved in the HIPARTI study. It has been very interesting and educational to follow your rehabilitation this past year.

Thanks to Ingrid Trøan and Ingvild Blich for all your help and support the last couple of months. I plan to repay you both in any way I can.

Finally, I would like to thank my family and friends. To my brother Peter, I'm so glad and proud that we are both finishing our master thesis this spring. Mom and dad, I could not have asked for more supportive parents and I'm truly grateful for all your help and encouragement, not just this last year... THANK YOU!

Oslo, 30.05.17
Janicke Magnus

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Definitions and abbreviations

ADL	Activities of daily living
AI	Acetabular index
CARE	CAse REport
CMS	Coleman Methodology Score
Exercise components	Treatment strategies that include elements of physical training
FAI	Femoroacetabular impingement
IHOT-33	International Hip Outcome Tool-33
LCEA	Lateral center edge angle
PT	Physical therapist
Physical-therapy led rehabilitation programs	Rehabilitation programs provided by a certified physical therapist containing elements of physical training
HIPARTI	Hip Arthroscopy International, with the title "Arthroscopic surgical procedures versus sham surgery for patients with femoroacetabular impingement and/or labral tears"
HSAS	Hip Sport Activity Scale
OUS	Oslo University Hospital
PICOS	Participants, intervention, comparison, outcome and study design
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-analyses
PRO's	Patient Reported Outcomes
RCT	Randomized Controlled Trial
Rehabilitation components	All treatment strategies included in a physical therapy-led rehabilitation program
ROM	Range of Motion
RTP	Return to Play
Structure of a rehabilitation program	Type and number of training sessions the time as well as the initiating of the rehabilitation program post-surgery
VAS	Visual Analog Scale

1 Introduction

A multicenter, international, double-blinded randomized controlled trial (RCT) on femoroacetabular impingement (FAI) was initiated at the Oslo University Hospital (OUS) at the same time as I was deciding the topic of my master thesis in Sports physical therapy. The RCT, referred to as the Hip Arthroscopy International (HIPARTI-study) (clinicaltrail.gov #NCT02692807), was evaluating the effect of hip arthroscopic surgery for patients with FAI and/or labral tears. The included participants would follow a progressive, semi-standardized physical therapy-led rehabilitation program three-months post-surgery. Limited evidence on the treatment of FAI was published at the time (1) and the physical therapy-led rehabilitation program applied was not yet evaluated. As a physical therapist (PT) interested in sports injuries, investigating an increasingly reported problem among the young and active population (2, 3) seemed like an interesting and important aim. The feasibility of the rehabilitation program needed to be described, and so, investigating the feasibility of a post-operative rehabilitation program for patients with FAI and/or labral tears became my master thesis.

An estimate of 30 participants were expected to be included in my master thesis from the HIPARTI during the first year of enrollment. However, the recruitment-rate was later and slower than expected, hence, only three participants finished their post-operative rehabilitation and were included. As a result, a systematic review on physical therapy-led rehabilitation for patients with FAI and/or labral tears was conducted as well. Supplementary data was extracted from the included studies so a thorough discussion of the content and feasibility of physical therapy-led rehabilitation of patients with FAI and/or labral tears could be undertaken.

Background

FAI was first described in 2003 by a Swiss orthopedic surgeon (4). Since then, FAI has emerged as a common intraarticular hip pathology, known to cause hip pain and restrictions in hip range of motion (ROM) in young adults (2, 5). FAI has been defined as a clinical hip disorder where specific symptoms, clinical signs and imaging findings all must be present (1). Based on the morphological changes present, is FAI divided into cam, pincer or mixed-FAI (6). Patients with FAI are often also diagnosed with labral tears, with similar symptoms and clinical signs present (7).

FAI is frequently seen in active subjects, and athletes participating in high-impact sports (basketball, hockey, and soccer) are found to be significantly more likely to develop cam deformities than non-athletes (8). The morphological changes in FAI are suggested to be a response of repetitive stress at the proximal femoral physis secondary to sporting activity during periods of skeletal growth (3). Repetitive stress may cause repetitive microfractures which can cause labral tears, articular cartilage damage and eventually may cause osteoarthritis (OA) (3).

Patients suffering from FAI can be treated with conservative or surgical treatment strategies (1). Conservative treatment often involves following a physical therapy-led rehabilitation (1). A combination of different rehabilitation components used to increase ROM, muscle strength, hip stability, neuromuscular control and movement patterns (1). Surgical treatment can be performed using either open- or arthroscopic surgery (1). The use of arthroscopic surgery is currently the most frequently used approach, with an increasing incidence reported in the United States (US) every year (9). Post-surgery, patients usually follow a post-operative rehabilitation program with similar content to the conservative rehabilitation programs (10-13). The post-operative rehabilitation is commonly divided into four or five rehabilitation phases, with specific goals and criteria for progression in each phase (6). The exact structure and content of these rehabilitation programs are currently not established (14).

Significance

To date, there are no high-level evidence for any of the treatment strategies used on patients with FAI and/or labral tears. However, as the rate of hip-arthroscopy procedures has increased the last couple of years (15), so has the interest of conducting high quality studies on the subject. Several ongoing RCTs are currently investigating the effect of hip arthroscopy followed by physical therapy-led rehabilitation program, including the earlier mentioned HIPARTI study (clinicaltrail.gov #NCT02692807). The results of these studies will not be published until 2017-2020 (1) and evidence regarding the effect of the surgical treatment of FAI will probably be unknown until they are published. High-quality RCTs on conservative and post-operative treatment of FAI patients are also being conducted (16, 17), but no studies are currently published.

The current guidelines on post-operative rehabilitation programs for FAI patients are based on descriptive studies, such as case reports and case series (6). With high-quality

evidence lacking, an assessment of the methodological quality of the current studies should be undertaken. Identifying the studies with the best methodological quality and describe the structure and content of these can assist PTs treating patients with FAI and/or labral tears in more informed and qualified decisions.

The feasibility of the published physical therapy-led rehabilitation programs, as well as the feasibility of the larger on-going studies, needs to be investigated as well. Feasibility studies are used to determine if an intervention is appropriate for further testing and may be used to identify what in the research method or protocol needs modification (18). A PT should know the safety and expected adherence, as well the potential progression of exercise and clinical improvements prior the initiating a specific rehabilitation program for patients with FAI and/or labral tear.

2 Research questions

The primary aim of this master thesis was to identify and describe the physical therapy-led rehabilitation programs for patients with FAI in the current literature, and discuss the structure, content and feasibility of these programs with the rehabilitation program used in the HIPARTI study. The results addressed the primary research question of this master thesis.

Primary research question

How are the physical therapy-led rehabilitation programs for patients with FAI and/or labral tears described in the current literature and how was the structure, content and feasibility compared to the rehabilitation program used in the HIPARTI study?

The secondary aims of this master thesis were to critically assess the methodological quality of the current literature on physical therapy-led rehabilitation of patients with FAI and/or labral tears and to evaluate the feasibility of the rehabilitation program used in the HIPARTI study. The results addressed the secondary research questions of this master thesis.

Secondary research questions

1. What is the methodological quality of the current literature on physical therapy-led rehabilitation programs for patients with FAI and/or labral tears?

2. Was the post-operative rehabilitation program used in the HIPARTI-study feasible for the first three participants included when evaluating their adverse events, compliance, progression of exercise and clinical change in hip function?

As an explorative study the master thesis didn't answer any hypotheses.

3 Theory

3.1 Anatomy

The Hip joint and Femoroacetabular Impingement

The hip joint is a multiaxial ball and socket synovial joint between the acetabulum and the femoral head (19). The acetabulum is cuplike with a horseshoe shaped articular surface and the femoral head forms two-thirds of a sphere, covered with hyaline cartilage (19). Directly attached to the rim of the acetabulum is the acetabular labrum. The labrum creates a 22% increase in articular surface and acts as a static stabilizer of the hip joint (7). The labrum also contributes to a more even distribution of the compressive forces applied to the hip joint by keeping the joint fluid in the central compartment (7). There are twenty-one hip muscles that provide stability, as well as movement across the hip (20). Abnormal performance of the hip muscles may alter the distribution of forces across the articular surfaces, potentially causing degenerative changes in the articular cartilage, bone and surrounding connective tissues (20).

In patients with FAI, abnormal premature contact between the femoral head and the acetabulum occur (1, 3). The contact, described as pathologic, occurs during hip motion and is secondary to abnormal hip morphology (1, 3, 21). Based on the morphology present, FAI is divided into cam- or pincer-type FAI (2). Most patients have a combination of the two types, referred to as mixed-type FAI (21). Only about 14% of FAI patients have pure forms of either cam or pincer-type FAI, with cam-type FAI being the most common (8, 21).

Cam-type FAI

In cam-type FAI the abnormality in the femoral head, caused by a flattening or convexity on the anterosuperior part of the femoral head-neck junction (22). The abnormality is often secondary to extra bone formation, developed during adolescence (3, 22). The alpha angle and the anterior head-neck offset can be used as parameters of quantification of asphericity on the femoral head. The alpha angle is the angle between the axis of the femoral neck and a line connecting the center of the femoral head with the femoral head/neck junction (21). The anterior head-neck offset is the difference in radius between the anterior femoral head and the anterior femoral neck on a cross-table axial view of the proximal femur (21). An alpha angle >50,5° and a head-neck offset <8

mm are considered key finding for cam-type FAI (2). The reduced head-neck offset is squeezed into the acetabulum causing repetitive microtrauma and impingement during hip flexion and internal rotation (3, 22). Cam-type FAI is suggested to lead to soft-tissue damage of the acetabular cartilage, labral tearing and potentially osteoarthritis (OA) in the hip (22, 23).

Pincer-type FAI

In pincer-type FAI there is an abnormality is in the acetabulum, causing an increased acetabular depth (3). The increased depth results in an overcoverage of the femoral head (21). The lateral center edge angle (LCEA) and the acetabular index (AI) can be used to quantified excessive acetabular coverage and increased acetabular depth (21). The LCEA is the angle formed by a vertical line and a line connecting the center of the femoral head with the lateral edge of the acetabulum. The AI is the angle formed by a horizontal line and a line connecting the medial point of the sclerotic zone with the lateral center of the acetabulum (21). A LCEA >40° and an AI <0° are common criteria for diagnosing pincer-type FAI (2). The increased depth in the acetabulum causes the femoral head-neck to repeatedly strike the acetabulum during hip flexion (3). Like in cam-type FAI, the repeated microtrauma can cause labral tears and articular cartilage damage, potentially causing OA changes in the hip (3, 23).

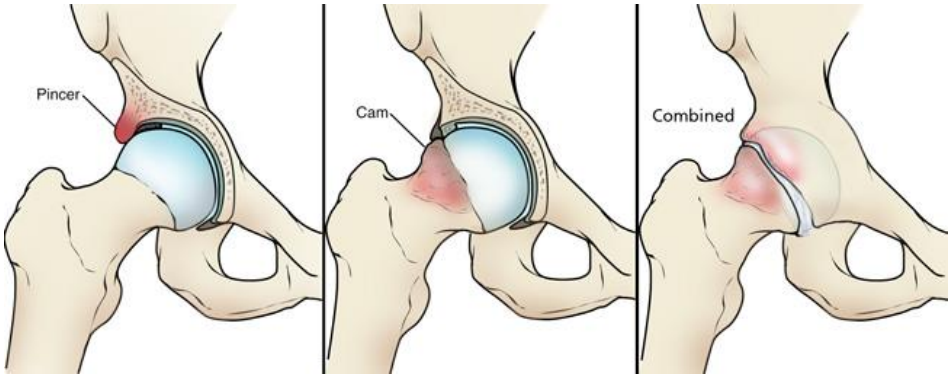

Figure 1: *Pincer, cam and mixed (here referred to as combined) Femoroacetabular Impingement (FAI).* Reproduced with permission from *OrthoInfo.* © American Academy of Orthopaedic Surgeons. http://orthoinfo.aaos.org.

Labral tears

A tear in the acetabular labrum is a well-documented source of hip pain (24). Most labral tears are located in the anterior or anterosuperior part of the labrum (13). Different causes of labral tears have been found, including hip trauma, capsular laxity and degeneration of the hip join (25). Most commonly are tears in the labrum due to bone abnormalities, such as hip dysplasia or FAI, in the hip joint (7, 24). Due to

degenerative changes the labrum tends to acquire a round morphology with advanced age (7). Labrum tears are the most common indication for hip arthroscopy (26).

3.2 Patient characteristics

FAI is usually found in patients younger than 50 years old (27). Cam-type FAI is more common in young men, with a near 3:1 male predominance, occurring at an average of 32 years (8, 21). Pincer-type FAI are found in both males and females, but are most common in middle-aged women, occurring at an average age of 40 years (8, 21). While a high prevalence of cam-type FAI is found in studies conducted on the western European population, have studies done in East Asian population found a markedly reduced prevalence (8). The role of genetics may of that reason be a predisposed factor in certain populations (8). Sports activity has been suggested as a potential risk factor for the development of FAI, especially those who involve repetitive hip flexion (28). A systematic review found that competitive male athletes participating in high-impact sports were significantly more likely to develop cam abnormalities than male non-athletes (odds ratio 1.9–8.0) (8). Repetitive stress at the proximal femoral physis, secondary to sporting activity during skeletal growth, are suggested to cause the morphological changes present in FAI (2). Current literature suggests that adolescent males playing soccer, ice-hockey or basketball, at least three times a week, are at greater risk of developing cam-type abnormalities (3).

Despite being commonly found in the active population, is FAI also found in people with a sedentary lifestyle (1). In addition, can FAI be associated with prior trauma, such as femoral neck fracture, or hip pediatric diseases, such as developmental dysplasia of the hip and Legg–Calve–Perthes disease (8).

Like FAI, are labral tears increasingly recognized as a common disorder in young and middle-aged patients (29). Labral tears are associated with bone abnormalities and often found in patients with FAI, as well as the other hip disorders associated with FAI (7, 29). Due to degenerative changes, are labral tears found in over 90% of the elderly population (7). Labral tears are also high in the general population, present in 66% of patients with mechanical symptoms of the hip (13).

3.3 Diagnose FAI

The recently published Warwick agreement on FAI included a pathway for the diagnosing and management of FAI patients (1) (**figure 2)**. A triad of symptoms, clinical signs and radiological features must all be present to diagnose FAI (1).

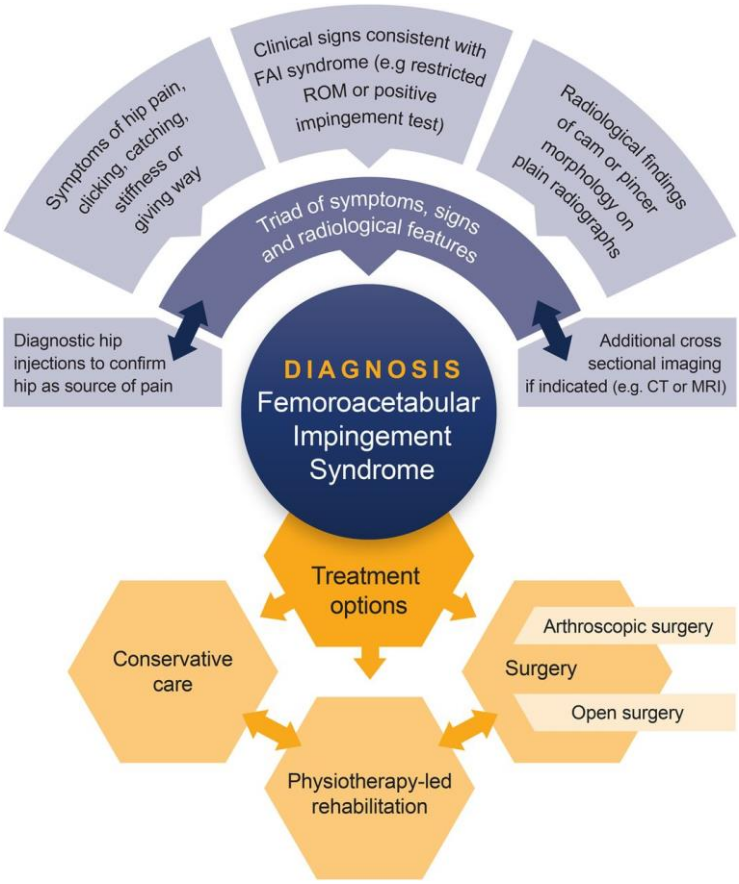

Figure 2: *Pathway for diagnosing and managing Femoroacetabular Impingement (FAI)* from The Warwick Agreement on femoroacetabular impingement syndrome (FAI syndrome): an international consensus statement, Griffin, Dickenson, et al., 2016, *Br J Sports Med*, *50*, 1169–1176. Copyright 2016 BJSM. Reproduced with permission

3.3.1 Symptoms

The primary symptom of FAI is pain (1). Hip- or groin-pain is most common, but pain in the lateral hip, anterior, lateral and posterior thigh, buttock, knee and lower back are also reported (1). The patients often describe a "deep anterior groin related pain" that worsen with prolong standing, sitting, and walking (2). Specific hip position (flexion, adduction and internal rotation) that re-produces the patients pain indicate FAI, as well as sports activity involving rotation and pivoting (2). As a intraarticular pathology, FAI may also give a sharp pain with clicking and giving way (2). Other mechanical symptoms may include catching, locking stiffness or restricted Range of Motion (ROM) (1). The presentation of symptoms can be variable, occurring in both an acute and

chronic setting (8, 27). Most common is an idiopathic presentation of symptoms, with ongoing atraumatic pain between 12 and 16 months (8). Symptoms are in general not reported as mild or subtle, but often severe and limiting in everyday life (1).

Symptoms found in patients with labral tears are similar to those found in FAI patients. Most common is sharp and dull groin pain that increases with activity (29) and mechanical symptoms of pain, clicking and locking of the hip (13). In the remaining sections of this chapter, further details on labral tears as a separate diagnosis will not be presented as many patients are suffering for both FAI and labral tears, with similar clinical signs, prognosis and treatment.

3.3.2 Clinical signs

Hip Range of Motion

Decreased ROM is the most commonly reported physical impairment in patients with FAI (30). Decreased ROM is particularly seen in positions of impingement (flexion and/or internal rotation in 90° flexion) (30). Studies have found a correlation between hip internal rotation deficit and radiographic evidence of cam-type FAI (2). Impairments in hip frontal, sagittal and transverse plane ROM during gait, squatting and stair climbing are also commonly found in FAI patients (30). However, the literature on this area is currently inconclusive (1). A recent systematic review found that hip ROM does not appear to differ between patents with FAI and control subjects, despite what previous research has shown (23). ROM restrictions were only significant in one low-quality study while data from five between-group studies showed no significant difference for all measures of ROM in patients with and without FAI (23).

Hip muscle function

Weakness in the hip muscle groups are found in FAI patients when compared to healthy controls (23, 31). Hip abduction strength seem to have the greatest deficit in the published literature (31-33), but also flexion, adduction and external rotation strength seem to be reduced (23, 31). An imbalance in the hip rotators and a significant difference in strength between antagonistic pair of muscles have been detected in patients with FAI (33, 34). Patients with FAI have also show an altered coordination of the deep hip muscles (35). Impairment in the contraction time for m. gluteus maximus have been discovered (36), as well as a reduced ability to activate m. tensor fasciae latae during hip flexion (31).

Trunk strength

Patients with chondrolabral pathology has been found to have a reduced performance on the side bridge test bilaterally compared to controls (37). The side bridge test is a test of trunk muscle performance and might be a surrogate measure of overall trunk endurance. Patients with FAI have also been found to have a reduced ability to control the position of the pelvis (37). Dynamic changes in pelvic tilt influences the functional orientation of the acetabulum, and an anterior pelvic tilt can result in earlier occurrence of FAI in the range of motion (38). Both these findings suggest that trunk strength is decreased in patients with FAI.

Gait and functional tasks

Patients with FAI have minimal impairments in gait biomechanics compared to matched controls (39). As mentioned, impairments in hip frontal, sagittal and transverse plane ROM during gait have been detected, as well as altered coordination of deep hip muscles (30, 39). Hunt et al. (40) found that participants with FAI walked slower and with significantly smaller cadences than the control group. The same study found a significantly less peak hip extension, adduction and internal rotation during stance, and significantly less peak external hip flexion and external rotation moments in the participants with FAI than in the control group (40). Significantly lower peak hip abduction during level gait have also been found in patients with FAI compared to the healthy controls (41).

FAI patients needed increased time to perform sit-to-stand task in Samaan et al. (42) and couldn't squat as low as the control group in Lamontagne et al. (43). Other studies have shown no significant between-group effects for squat depth, but a reduced dynamic balance on one leg in FAI patients (23).

3.3.3 Clinical testing

Since a decreased hip ROM is commonly found in FAI patients it's important to clinically measure the patient ROM (1). The use of electronic devices to, such as digital inclinometer or goniometer, are suggested to be better than standard goniometry (2). An examination of the patients gait, single leg control and muscle tenderness around the hip is also important when FAI is suspected (1). Several special tests can be performed to examine the presents of FAI (1). The most commonly used test is Flexion-Adduction-Internal rotation (FADIR) (1). Another test frequently used is Flexion-Abduction-External Rotation (FADER) (2). Reproduction of the patient reported hip or groin pain

and/or mechanical symptoms indicates a positive test (2). It's also important to examine the groin for other structures that can produce similar pain (1). To determine if the pain is really related to the hip joint a local anesthetic injection can be used (1). If the injection results in pain relief an intra-articular diagnosis, such as FAI, is more likely present (1).

3.3.4 Patient reported outcomes

Several patient reported outcomes (PRO's) have been developed for individuals with hip pathology (44). For assessment of young and middle aged adults with hip related pain, undergone non-surgical treatment or hip arthroscopy, are the Hip Outcome Score (HOS) and International Hip Outcome Tool-33 (IHOT-33) recommended (45). However, the IHOT-33 has been suggested to be more valuable than the HOS in patients undergone hip arthroscopy (46).

3.3.5 Diagnostics Imaging

To diagnose FAI a morphological assessment of the hip is required (1). Radiological imaging can be used to identify cam and/or pincer morphology, as well as providing a general overview of the hip and identify other causes of hip pain (1). As mentioned are an increased alpha angle and anterior head-to-neck-offset commonly used to diagnose cam-type FAI, while an increased LCEA and a decreased AI are used to uncover pincer-type FAI (2). Among the different types of imaging used to diagnose FAI are radiographs, computer temography scans, diagnostic ultrasound, magnetic resonance imaging (MRI) and magnetic resonance arthrography (MRA) (2). MRI and MRA are currently the preferred techniques for diagnosing intra-articular hip pathologies (2).

It is important to notice that several individuals may have a cam and/or pincer morphology on radiographs without having FAI (47). As seen on **figure 2**, a triad of symptoms, clinical signs and radiological features must all be present to diagnose patients with FAI (1).

3.4 Prognosis

The long-term outcome for patients with FAI is still unknown, but the symptoms of FAI patients who do not receive treatment will probably worsen over time (1). A significantly higher number of the FAI patients who received treatment within 12 months of developing symptoms returned to sports compared to those with a longer

duration of symptoms (48). A systematic review found moderate evidence that increased alpha angle is associated with the progression of FAI to labral pathology (49). The same review found no association between increased alpha angle, or other numerous radiographic variables, in respect of development of OA (49). However, other studies in the current literature suggest an association between longstanding FAI and OA (50). Agricola et al. (51) found that a moderate (alpha angle>60°) and severe (alpha angle>83°) cam-type deformity resulted in adjusted odds ratio of 3.67 and 9.66, respectively, for end-stage OA.

3.5 Treatment

Strategies and evidence

The treatment for FAI can be divided into two different strategies; conservative and surgical (1). Since there are strong evidence that FAI is a mechanical disorder secondary to abnormality in the hip anatomy, one might argue that surgery involving a correction of these abnormalities might be the most appropriate treatment option (14). However, to date there is no high-level evidence supporting any treatment strategy used on FAI. Several high-quality studies are currently being conducted, investigating the effect of hip arthroscopy (UK FASHIoN study[1], Aus FASHIoN[2], FAIT study[3], FIRST study[4], HIPART study and US MHS study[5]), but currently are reviews on the treatment of FAI based on low-quality evidence (14, 52, 53).

A recently published systematic review investigated and summarized evidence for all treatment strategies for FAI patients (54). Out of the 18 studies included, did 16 studies investigated different surgical treatments, while only 2 investigated the effect of conservative treatments (54).

3.5.1 Conservative treatment

Conservative treatment for patients with FAI may include passive treatment strategies such as oral analgesia including non-steroidal anti-inflammatory drugs, intra-articular steroid injection and watchful waiting (1). Studies have shown that conservative treatment for FAI can achieved good early results and reduce symptoms, so long as the

[1] UK FASHIoN study (clinicaltrail.gov #ISRCTN64081839)
[2] Aus FASHIoN (clinicaltrail.gov #ACTRN12615001177549)
[3] FAIT (clinicaltrail.gov #NCT01893034)
[4] FIRST study (clinicaltrail.gov #NCT01623843)
[5] US MHS (clinicaltrail.gov #NCT01993615)

patients can modify actives of daily living (ADL) and adapt their activity to their hip morphology (55). Activity modification was the most frequently recommended treatment strategy in reviews and discussion articles included in a systematic review on conservative treatment of FAI (14). More active conservative treatment strategies, such as physical therapy, were promoted in nearly half (48%) of the included literature (14).

A general opinion seems to be that patients with suspected FAI should participate in a conservative rehabilitation program before considering surgical treatment (14, 56). The conservative rehabilitation, often led by a physical therapist, aims to reduce the patient's symptoms by improving hip ROM, strength, stability, neuromuscular control and movement patterns (1). Since different physical therapist (PTs) seem to use different treatment strategies, details of what the physical therapy-led rehabilitation should include is currently not established (14).

A conservative rehabilitation program, based on Emara et al. (55), was compared to arthroscopic surgery in a pilot-RCT Griffin et al. (57). The rehabilitation program included activity modification, the use of anti-inflammatory drugs, stretching exercises and instructions to adapt to their safe range of movement (55). The conservative program was found to be feasible, with satisfactory compliance to the rehabilitation program. However, the progression of exercise, clinical change and adverse events were not reported. A feasibility study investigating these elements of a rehabilitation program for patients with FAI and/or labral tears are still lacking in the current literature.

A more active conservative rehabilitation program, including physical therapy-led rehabilitation, was used in a clinical outcomes study conducted on patients with clinical presentation of prearthritic intra-articular hip disorders, including FAI and labral tears (58). The study found that 44% of the 52 patients who completed the study were satisfied with conservative care, while 56% chose to have surgery. However, all patients demonstrated equally significant improvement in all outcome measures from baseline to one year (58). The results of this study indicated that physical therapy-led rehabilitation may be a valid choice of treatment for patients with FAI and/or labral tears.

3.5.2 Surgery

Surgical treatment of FAI aim to correct hip morphology and create impingement-free motion (1). The femoral head can be reshaped, the femoral neck angle adjusted and the acetabulum rim trimmed (1). Damage to the labrum or articular cartilage can be

resected, repaired or reconstructed (1). The surgical treatment of FAI can be performed by open or arthroscopic surgery (1). As a less invasive procedure, with less muscle dissection, arthroscopic surgery will allow patients to recover faster and potentially return to play (RTP) earlier than open hip surgery (1, 59, 60). However, hip arthroscopy is considered a more technically demanding procedure and the literature still suggests the use of an open approach in some cases where bone deformities are difficult to address (1, 60).

Arthroscopic surgery

Hip arthroscopy is considered a relatively new procedure in the treatment of hip disorders (44). The procedure has advanced tremendously the last two decades, and combined with a greater understanding of hip pathology, has the number of hip arthroscopic surgeries increased rapidly the last couple of years (44, 59). Especially the incidence among the 20 to 39 year-old patients has increased since 2004 (9). Indications for hip arthroscopy include FAI, labral tears, loose bodies chondral defects and degenerative conditions of the hip (44). The current literature has found patients with FAI and/or labral tears to have preferable results, with decreased pain, increased ROM and increased activity level, after arthroscopic surgery (61).

Complications after arthroscopic surgery

Even though hip arthroscopy surgery is considered to be a less invasive approach than open surgery, complications might still occur (62). The complication rates associated with hip arthroscopy are generally low and ranges from around 1% to 8% in the current literature (62). Data from a systematic review and meta-analysis of 6962 cases reported an overall complication rate of 4,0% (59). The majority (99.7 %) of complications reported in the systematic review were minor, being non-life or limb threatening in nature (59).

3.6 Post-operative rehabilitation

Current evidence

There is a lack of evidence on postoperative rehabilitation after hip arthroscopy in general and for patients diagnosed with FAI (6). The literature that does exist are descriptive in nature, with the best evidence being level 4 case series or case reports (6). The low-quality studies have shown successful results regarding pain, function and RTP in patients with FAI (6). Currently, two RCT-studies are investigating postoperative

rehabilitation of FAI patients after arthroscopic surgery (16, 17). Several reviews, research articles and clinical commentaries on post-operative rehabilitation after hip arthroscopy are published (63-68), as well as literature on post-operative rehabilitation for patients diagnosed FAI and/or labral tears (10-13). The reviews, research articles and clinical commentaries describe the content of different postoperative physiotherapy protocols, but an evaluation of the feasibility of these protocols are currently lacking.

Principles of the postoperative rehabilitation

The primary goal of the post-operative rehabilitation program for FAI patients is to reduce symptoms and improve function (66). Healing, ROM, muscular strength, biomechanical assessment and psychological preparedness, combined with the patients age, preoperative status, underlying comorbidities and surgical procedure are the greatest deciding factors for progression in a post-operative rehabilitation program after hip surgery (63, 69). A patient with labral repair, and otherwise healthy joint, may progress much more aggressively than a patient undergoing abrasion arthroplasty or microfracture (66). The progression should also be individualized according to the patient's own goals and expirations (69). Depending in the level of compliance and understanding of progression can a homebased rehabilitation program be sufficient for many FAI patients (66). However, to ensure that compensatory strategies are not adopted throughout the weight-bearing progression, are supervised training sessions also recommended in the post-operative rehabilitation of FAI patients (63).

The content of the post-operative rehabilitation in the current literature can be summarized through seven rehabilitation components; treatment of ROM, hip muscle strengthening, trunk strengthening, neuromuscular and functional exercise, cardiovascular training and patient education.

Treatment of ROM

Passive ROM exercises and gentle stretching within tolerance may be initiated the first week post-surgery (65, 66). Initiating ROM-exercises early, especially passive flexion and internal rotation, may prevent intra-articular adhesions between the hip joint and the acetabular labrum (66). After a few weeks the ROM-exercises may progress from passive to active and from mid- to end-range (65). It has been suggested that moderate pain with stretching becomes acceptable at week ten if full ROM is still lacking (13).

Manual therapy techniques can also be applied early in the rehabilitation period to address soft tissue restrictions of the hip and pelvis (65). Techniques such as soft tissue massage, trigger point therapy and manual mobilizations, including traction and glides of the hip and pelvis, are suggested until normal ROM is reached (17, 66). Few studies have investigated the effect of manual therapy on FAI and/or labral tears post-surgery, but one case report found manual therapy, with a combination of soft tissue mobilization and trigger point needling, to be very effective post-surgery for a patient with FAI and labral tear (70). The effect of a manual therapy program on hip function has previously been found superior to an exercise therapy program for patients with OA (71).

Hip muscle strengthening

Gentle strength exercises, such as submaximal isometric exercises of the lower extremity, are initiated during the first day post-surgery (10). After a few weeks other non-weight bearing strengthening exercises of the hip muscles can be initiated (10). It's important to address the timing of the gluteal function early in the rehabilitation program, before initiating additional gluteal strengthening and stabilizing exercises (68). Exercises targeting the gluteus medius are considered essential to facilitate pelvic stability in the frontal plane and considered critical to the success of progression of functional exercises, especially in single-leg exercises (10).

General strength exercises of the lower extremities with weight-bearing are typically initiated four to six weeks post-surgery (10). The strengthening exercises are progressed from closed-chain bilateral dynamic stability exercises to unilateral exercises (68).

Trunk strengthening

Trunk strengthening is considered an essential component in the post-operative rehabilitation of FAI patients (13). Strengthening the proximal stabilizing musculature of the trunk and pelvic is important to increase for pelvic stability and abdominal control (66). Targeting bilaterally trunk muscle performance in the post-operative rehabilitation was supported by the decreased performance in side bridge test found in Kemp et al. (37).

Neuromuscular control

Reestablish neuromuscular control is an important part of the post-operative rehabilitation program for FAI patients (66). Exercises for neuromuscular control should progress from simple to complex, stable to unstable, slow to fast, low to high

force and from general to specific (66). Eventually the neuromuscular training should progress to exercises that combine balance and strength (66).

Functional exercises

Functional exercises should be applied and adjusted to fit the patients goals and specific demands of the activity (10). Functional exercises may include advanced strength and neuromuscular control, such as lunges, side to side lateral agilities, forward and backward running with a cord and initiation of running progression (64). Polymetric exercises, such as countermovement jumps or box jumps, and agility drills, such as cutting, sprinting and decelerating, should be progressed to the level of the activity the patient is returning to (65).

Cardiovascular training

Patients should begin cardiovascular training on a stationary bike without resistance during the first week post-surgery (65). As soon as the patient regain a normal gait, longer walks should be implemented. Other weight bearing activities, such as cross-trainer, stepper machine or stair-climber, are often initiated at between week six and eight (10). Swimming and biking with resistance are also suggested at this time (64). A running program is typically initiated at approximately twelve weeks, starting with short intervals of low-intensity (10). In the last stages of the rehabilitation cardiovascular training in the form of sport-specific drills should be applied (64).

Patient education

Patient education is considered the foundation of any rehabilitation program (66). Letting the patient set their own goals has been found to have a positive effective on clinical outcomes (72). Knowledge of potential effects of the treatment is an important part of realistic goal-setting (72). The patient should also know the related precautions and the recommended progression for his or her situation (66). The treating PT should encourage the patients to learn about their condition, as well as to accept responsibility for their own rehabilitation (72). The importance of a normal weight and achieving nonantalgic gait early, is important information for FAI patients postoperatively (63). For the patient to achieve a successful outcome is compliance to the rehabilitation program critical (72). Patient education that is well-planned, well-delivered and targeted to the needs of the individual patient may contribute to an increased compliance (72).

Postoperative phases

The literature proposes the use of a four to five stage postoperative rehabilitation program for FAI patients (6). A summary of the recommend goals, treatment strategies, precautions and criteria for progression from the current literature on rehabilitation following hip arthroscopy can be seen in **table 1.** Duration of each phase is listed, but these timelines are only suggestive, as progression should be based on successful completion of the criteria listed (63). The recommendations listed in **table 1** are not specific to FAI patients.

Table 1: *Post-operative rehabilitation phases after hip arthroscopy*

Phase	Duration	Goals	Treatment strategies	Precautions	Criteria for progression
1	From surgery to week 4-6 post-surgery (63, 68)	Decrease swelling, pain and inflammation (64) Protect the repaired tissues and reducing risks of scar adhesions (64) Restore Range of Motion (ROM) within restrictions (64) Prevent muscle inhibition and development of anterior hip contracture (64)	Manual therapy (64) Passive/active ROM (65) Isometric exercises of the lower extremity (64) Nonresistant stationary bike (64)	Do not push through hip pain (64) Specific ROM restrictions (surgery depended) (64) Weight-bearing restrictions (surgery depended) (64)	Minimal pain (64) Close to full ROM (64) Proper muscle firing in all exercises (64) Nonpainful full weight bearing (64)
2	From week 4-6 until week 7-8 post-surgery (68)	Protect integrity of repaired tissue (64) Restore full ROM (62) Progressively increase muscle strength (61) Improve neuromuscular control (39) Initiate functional exercises (39)	Gait training (39) ROM exercises, including soft tissue and muscle stretching (39) Progressive strength and endurance exercises of the hip and trunk muscles Exercises for neuromuscular control (66) Functional exercises with pelvic stability Cardiovascular training (39)	No forced stretching (64) No treadmill use (64) Avoid hip joint irritation (64)	Pain-free/normal gait pattern (64) Full ROM (64) Hip flexor muscle strength >60% of the uninvolved side (64) All other hip muscle strength >70% of the uninvolved side (64) Successfully initiated functional exercises (11) No joint inflammation or muscular irritation (39)

Phase	Duration	Goals	Treatment strategies	Precautions	Criteria for progression
3	From week 8 post-surgery, with a total duration between 4 and 12 weeks (67)	Restore muscular strength and endurance (39, 64) Optimize neuromuscular control (39, 64) Restore cardiovascular endurance (39, 64) Progress to sport related activity (39)	Progressive strength and endurance exercises of the hip and trunk muscles (67) Progressive neuromuscular control (66) Progression of functional activities and sport (39) Progression of cardiovascular training (64) Running and agility drills should be introduced (11)	Treadmill use, still not recommend (39, 61) Avoid hip flexor and adductor irritation (39, 64) Forced or aggressive stretching that elicits pain (39, 64) Avoid contact and high velocity activities (39, 64)	Full pain-free ROM (63) Hip flexor muscle strength, >70% of the uninvolved side (64) All other hip muscle strength >80% of the uninvolved side (64) Perform all exercises pain free and with correct form (11) Cardiovascular fitness equal to preinjury level (64) Demonstration of initial agility drills (64)
4/5*	Duration depends on function and activity patient is returning to	Restore power and maximize plyometric strength (39) Understands proper care for the long-term health of the hip (39) Independent in maintenance program (39) Return to play (63)	Power, plyometric and performance training (39) Individualized hopping and agility drills Jogging progression program/or other conditioning (39, 60) Sports training (39) Developing a return to sports plan (39)	No specific precautions unless noted by the physician (39)	Cleared by the physician (39) Full pain-free ROM (61) Hip strength >85% of the uninvolved side (61) Completion of functional sport test (61) Performing sport-specific drills a full speed without pain (61)

*The post-operative rehabilitation can be divided into four or five rehabilitation phase. In this table the duration, goals, treatment strategies, precautions and criteria for progression are summarized for phase 4 and 5.

Return to play

Arthroscopic surgery for FAI resulted in a RTP of 73% in top-level athletes (48) and 86% in all athletes (73). The rate of return to the same sport level as before the occurrence of symptoms in the same groups were 52% and 84% receptively. An agreement between the patient, treating surgeon and the supervising PT must be present, as well as passing both objective and subjective criteria (63). The patient must demonstrate full ROM, close to normal muscle strength in the trunk and lower extremities, cardiovascular endurance consistent with the sport and/or activity the patient is returning to and ability to perform sport-specific drills at a competitive level without pain (63, 69). No single clinical tool is currently available to predict successful RTP (63), but a number of specific functional- and RTP-tests are used to evaluate if

RTP is appropriate (11-13, 63, 64, 69). The testing should always be adjusted to the patient's specific sport and/or activity (63).

Complications in the postoperative rehabilitation

Complications can occur during the post-operative rehabilitation of FAI patients. Tendonitis in the hip flexor region and in the iliotibial band region have been found in several FAI patients post-operatively (10). Another common complications is the lack of progression of hip ROM (10). The majority of postoperative rehabilitation complications can be avoided be adapting the rehabilitation to the patients pain and symptoms, and continue to monitor any symptoms that may occur throughout the rehabilitation period (10). In addition, are compliance to the post-operative restrictions and known precautions considered critical to avoid complications (10).

4.1 Method – part I

4.1.1 Study design

The first part of this master thesis was designed as a systematic review. The aim was to locate, evaluate and describe the content and feasibility of conservative and post-operative physical therapy-led rehabilitation programs for patients with FAI and/or labral in the current literature. The systematic review was conducted according to the guidelines provided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) statement (74), following the PRISMA checklist (75).

4.1.2 Search of literature

A systematic search of literature was conducted according to sections on method on the PRISMA checklist (75). Search terms related to FAI, rehabilitation and different outcome measures were selected and categorized according to the PICOS-model (Participant, Intervention, Comparison, Outcome and Study design) (75). Due to already knowledge of limited high quality literature on the subject, the search was conducted without the "comparison-component". The systematic search was performed in the following databases: PubMed, SportDiscus and Web of Sciences. The search strategy from the systematic search can be seen in **table 2.** A grey literature search was conducted in the Google Search Engine and in Google Scholar. Finally, reference lists of published systematic reviews on the topic was reviewed to locate additional literature that the search may have missed (1, 14, 60). The search of literature took place from November 2016 until February 2017 and all primary literature published until January 2017 was screened and considered for inclusion.

Table 2: *Electronic databases and search terms used in the systematic search of literature*

Database	Search terms
PubMed[a] SportsDiscus Web of Sciences	(FAI OR "FAI syndrome" OR "Femoroacetabular impingement" OR "Hip impingement" OR "Labral tear" OR "Hip injuries/pathology" OR "Hip Joint/pathology") AND (Rehabilitation OR "Exercise therapy" OR "Physical therapy" OR Physiotherapy OR "Conservative treatment" OR "Conservative management" OR "Conservative intervention" OR "Non-surgical") AND (Feasibility OR Progression OR "Treatment outcome" OR "Outcome measures" OR Function OR Pain OR "Range of Motion" OR Strength OR "Activities of Daily Living" OR "iHOT-33" OR HOOS OR HSAS OR HUNT OR "Return to play" OR "Return to sport")

[a] = the search term *Rehabilitation* was in the PubMed database conducted with the ending [tw] to narrow the search down to following fields: title and abstract

4.1.3 Inclusion

Inclusion- and exclusion criteria were developed to make sure that the included studies contained participants, interventions and outcomes that could be compared to the study selection and intervention in part II (**table 3**). The titles of literature published in English, Norwegian, Danish or Swedish were screened for eligibility, before the abstracts and full texts of studies of interest were evaluated.

Table 3: *Inclusion- and exclusion criteria for inclusion of studies in the systematic review*

	Inclusion criteria	**Exclusion criteria**
Participants:	Patients with clinically and radiographically diagnosed FAI and/or labral tear or patients with morphological findings of FAI located in arthroscopic surgery. Patients with partial labral tear may also be included. The mean age of the participants must be >18-years-old with no prior operative or post-operative treatment	Only adolescent participants Participants treated bilaterally
Intervention:	The intervention had to include a post-operative physical therapy-led rehabilitation program after unilateral hip arthroscopic surgery or a conservative physical therapy-led rehabilitation program. The rehabilitation program had to be described in detail, have at least 1 supervised training session and include >1 exercise component (such as strength, neuromuscular or functional exercises)	Open surgery as surgical procedure A conservative treatment protocol with only wait-and-see, activity-modification, education, NSAID* and stretching as treatment strategies. Therapy-led rehabilitation delivered by a certified athletic trainer (ATC), not certified physical therapist (PT)
Outcome measures:	At least one of the following outcome measure reported; hip range of motion (ROM), hip strength or hip related patient reported outcomes	Return to play as only outcome measure, with no mention of hip ROM, hip strength or a measurement of hip function or pain
Study design:	All case report/series and clinical trials	Research articles and clinical articles

*Nonsteroidal Anti-Inflammatory Drugs

4.1.4 Quality assessment

A modified Coleman Methodology Score (CMS) (76) was used to assess the methodological quality of the included studies. The original CMS was based on the Consolidated Standards of Reporting Trials (CONSORT) statement and designed to assess RCTs investigating surgical treatment of patellar tendinopathy (76). The CMS consist of two parts (76) and was in our study modified to assess low-quality studies on physical therapy-led rehabilitation of patients with FAI and/or labral tear. In part A, the following scoring criteria were modified to fit our included studies: section 1 (**study size**) was modified from the number of tendons to the number of participants, section 4

(**study design**) was modified to include case series or case reports, which were assigned a score of 0 (same as retrospective cohort studies), section 5 (**diagnostic certainty**) was modified to included clinical signs and radiographic imaging or clinical signs and morphological findings located in arthroscopic surgery, section 6 (**description of surgical procedure given**) was modified to describe the treatment given, as surgical procedures were not relevant in this study, and section 7 (**description of postoperative rehabilitation)** was altered to only score the compliance to the physical therapy-led rehabilitation, as the description already was scored in section 6. In part B, modifications were only made in section 2 (**procedure for assessing outcomes**) where surgeons' files were replaced with patient files and investigator independent of surgeon was replaced with investigator independent. A perfect score of 100 represents a study design with little influence of chance, different biases and cofounding factors (76).

4.1.5 Data extraction

To be able to compare the physical therapy-led rehabilitation programs in the literature to the physical therapy-led rehabilitation program described in part II structure, content and feasibility of the rehabilitation programs were extracted from the included studies. Studies who investigate feasibility are used to determine if an intervention is appropriate for further testing and may be used to identify what in the research method or protocol needs modification (18). The feasibility of a rehabilitation program can be evaluated by looking at the participants' adverse events, compliance to the program and clinical changes (77). Due to the inclusion criteria, were only data from the intervention groups in studies with a control group extracted.

Structure of the rehabilitation programs

To illustrate how the included rehabilitation programs were structured, the type (supervised or home) and number of training sessions were extracted from the studies. The time of initiating the post-operative rehabilitation programs was also extracted from the included studies

Supervised trainings sessions

Supervised training sessions were defined as any meeting between the treating PT and the participant(s) related to the rehabilitation. These sessions often include patient education, treatment of ROM and/or physical training.

Home training sessions
Home training sessions were defined as all treatment and/or training sessions related to the rehabilitation not overlooked by the treating PT. These sessions usually only include physical training.

Content of the rehabilitation programs

The content of the rehabilitation programs was described by extracting the reported rehabilitation components from each study. Each rehabilitation component was used as common term to describe all treatment strategies with the same goal of treatment. Rehabilitation components who involve physical exercises were referred to as exercise components.

Post- operative restrictions were not extracted from the post-operative rehabilitation programs. They were considered a part of the surgical procedure and not the physical therapy-led rehabilitation in our study.

Rehabilitation components
The treatments strategies reported in each study were placed in one of the nine following rehabilitation components; manual therapy, stretches, hip ROM exercises, hip strength, trunk strength, neuromuscular training, functional exercises, cardiovascular training or patient education.

Description of exercise components
The following five rehabilitation components were defined as exercise components; hip strength, trunk strength, neuromuscular training, functional exercises and cardiovascular training. How detailed the description of the exercises applied was in each study were extracted from the studies.

Feasibility of the rehabilitation programs

Feasibility of the rehabilitation program applied in each study was evaluated by extracting adverse events, compliance, progression of exercise and clinical changes.

Adverse events
Any event or complication that was defined as an adverse event by the authors of the included studies was extracted accordantly.

Compliance
The participants mean compliance, as well as criteria for compliance defined by the authors in each study, was extracted accordantly.

Progression of exercise
Progression of exercise represents an increase in the level of exercise performed by the participants throughout the rehabilitation period. Progression of exercise could be evaluated by the progression of the individual exercises, the rehabilitation components or the rehabilitation phases described. Recommended time-lines in each rehabilitation phases could be used to illustrate the progression of exercise, or when documented, the actual documented time spent in each rehabilitation phase.

Clinical change in hip function and pain
Clinical change in hip ROM, hip muscle strength, validated hip-related PRO's and/or measurements of hip related pain were extracted from the included studies outcome measures.

4.1.6 Data handling
The data extracted from the included studies was handled separately for all studies. Study characteristics were summarized using mean values for age and percentage for gender distribution and an average score of the methodological quality was calculated. The clinical change in hip function and pain were presented together, but not summarized in any way.

4.2 Method – part II

4.2.1 Study design

The second part of this master thesis was designed as prospective case-series. The post-operative rehabilitation of the first three participants included in the HIPART study (clinicaltrail.gov #NCT02692807) was used to describe the content of the HIPARTI rehabilitation program and evaluate the feasibility of the program. The Case Report (CARE) checklist (78) was used as guidelines (**appendix 9**).

4.2.2 Inclusion

All patients referred to Oslo University Hospital (OUS) for a hip-arthroscopy after February 2016 were evaluated and considered for inclusion in the HIPARTI study (clinicaltrail.gov #NCT02692807) by two orthopedic surgeons at the hospital. The patients underwent a clinical exam by the orthopedic surgeons and standardized radiographs of the anterior pelvic and Dunn-view with 45° flexion, 20° abduction and 0° rotation. A MRI of the hip and pelvis was also taken. The alpha angle and the LCEA was used to determine the presence of FAI. Patients who fulfilled the inclusion and exclusion criteria (**table 4**) were asked if they wanted to participate in the HIPARTI-study. Due to a limited timeframe, only data from participants who completed the three-month post-operative rehabilitation program before February 2017 were included in the case series.

Table 4: *Inclusion and exclusion criteria in the HIPARTI-study*

Inclusion criteria	Exclusion criteria
Patients between 18 and 50 years of age Hip pain during daily and/or sporting activities Intra-articular hip pain with radiological signs of FAI and/or labral tears eligible for hip arthroscopy (to be determined in a pragmatic fashion by the surgeon based on clinical examination and imaging) The patient is able to give written informed consent and to participate fully in the interventions and follow-up procedures	Pain that is not confirmed by physical examination of the hip Evidence of preexisting osteoarthritis, defined as Tonnis grade >1, or less than 3mm superior joint space width on AP pelvic radiograph Center edge angle on radiograph <25°; (v) previous known hip pathology such as Perthes' disease, slipped upper femoral epiphysis or avascular necrosis Previous hip injury such as acetabular fracture, hip dislocation or femoral neck fracture Previous hip surgery

	Medical conditions complicating surgery (ASA 3); (ix) inflammatory joint disease (RA, Bechterew etc) Physical inability to undertake testing procedures Expected lack of compliance such as cognitive impairment, drug abuse or similar; Inability to understand the written and spoken language of the treatment center; **Contra-indications to placebo surgery:** A large loose body, chondral flap >1cm^2 detached at 3 sides, complete labral radial flap tear and labral bucket-handle tear with complete avulsion >1.5cm long

4.2.3 Baseline and follow-up assessments

Baseline assessments were performed as close to surgery as possible, at a maximum of one week prior to surgery. Participants demographics was gathered, as well as physical measurements. The participants' activity level was scored using the Hip sport activity scale (HSAS) (79). A clinical examination by two trained PTs, of whom one was the research coordinator, was performed to obtain baseline data on the participants' pre-operative status. All participants returned to OUS for a follow-up assessment with the research coordinator and an additional PT after completing the three-month post-operative rehabilitation.

4.2.4 Interventions

Arthroscopic surgery

The participants were randomized to either receive unilateral hip arthroscopy including surgical treatment or only unilateral diagnostic hip arthroscopy. Any labral, chondral and bony pathology (cam or pincer) was treated for participants randomized to receive hip arthroscopy. For all participants, a diagnostic round in the central and peripheral compartment was performed. Labrum, cartilage, and other possible conditions were inspected and findings documented. If the orthopedic surgeon found any contra-indications to placebo surgery, as those listed at the bottom of **table 4,** the participant was excluded from the study.

The post-operative rehabilitation

The post-operative rehabilitation program used in the HIPARTI was named the HIPARTI study Rehab Plan (HIPARTI rehab program) (**appendix 2**). The HIPARTI rehab program was originally developed as both a pre- and post-operative program for patients with FAI and/or labral tears, based on the current knowledge of highest evidence for physical impairments in FAI (23). A discussion and consensus by two senior PTs and six PTs involved in the HIPARTI-study took place in Oslo prior to inclusion of participants.

The six PTs, working at four different private physiotherapy clinics in the Oslo area, were instructed on how to use the HIPARTI rehab program, as well as how to collect appropriate data. They were also encouraged to contact the research coordinator or the author of this study if they had any questions or concerns during the rehabilitation period. Based on the participants own preference, regarding what clinic they wished to visit, one of the six PTs were selected to follow the participant through his/her rehabilitation.

Several post-operative restrictions were included as part of the HIPARTI rehab program:

- No hip flexion beyond 90° until 2 weeks post-surgery
- Crutches for the first 2 weeks postoperative
- No manual traction for capsular tightness until 12 weeks post-surgery
- No Level 2 cardiovascular exercises until at least 12 weeks post-surgery (this includes running), and level 3 cardiovascular until 6 months post-surgery (this includes football) unless approved by the surgeon

All participants were encouraged to start their physical therapy-led rehabilitation within the first two weeks of surgery. The treating PT was instructed to follow their patients closely, arranging supervised session approximately once a week during the rehabilitation period. At the end of each supervised session the treating PT made an individualized home exercise program for the participant. The rehabilitation period was defined as the 12 weeks following the date where the participant received his/her first home exercise program. This ensured that compliance was evaluated fairly for all cases. The home exercise program could include exercises for hip muscle strength, trunk strength, functional exercises and cardiovascular training. The PT could also instruct the participant to execute cardiovascular training as separate home sessions. The

cardiovascular training had to be documented with both intensity, load and duration to be considered a home training session. Activities such as long walk or cross-country skiing preformed at the participants own initiative were not considered home training sessions.

Rehabilitation components

The HIPARTI rehab program consisted of six key components; ROM, hip muscle strength, trunk strength, functional task performance and additional lower limb strength (functional exercises), cardiovascular training and patient education. All six components could be included in all stages of the rehabilitation period. Since the HIPARTI rehab program was a semi-structured physical therapy-led rehabilitation program the treating PT adjusted the rehabilitation program to each individual participant.

1) Hip range of Motion

The first component, ROM, was included in the supervised training sessions if the participant did not have a hip flex of >116° or > opposite side at the beginning of each training session. Several different targets of treatment and treatment options were listed in the HIPARTI rehab program to give the treating PT options in regards of appropriate treatment. All treatment strategies for ROM were listed as the same level of progression.

2) Hip muscle strength

The second component, hip muscle strength, included different exercises to increase hip extension, abduction, adduction and external rotation strength. Strengthening exercises for each hip muscle group were listed separately with several different levels of progressions of each muscle groups (extension: 1-2, 7-14, abduction: 1-13, adduction: 1-4, external rotation: 1-3). Some of the exercises were listed as more than one level with an increase in number of series and/or repetitions in the higher levels. In the HIPARTI rehab program the level of progression was referred to as phases, not to be confused with phases of rehabilitation. In this master thesis, the term level of progression will be used to describe the progression of exercises to avoid confusion, as seen in the Norwegian user-manual (**appendix 3**).

Figure 3: *Examples of hip muscle strength exercises from the HIPARTI rehab program (**appendix 2**).*
(a): Hip extension level 1-2, (b): Hip abduction level 4-6, (c): Hip external rotation level 1.
Exercises with more than one level listed represents more than one level of exercise due to an increased number of repetions.

3) Trunk strength

The third component, trunk strength, included different levels of progressions for exercises aimed to increase trunk strength and endurance (level: 1-12). Since muscle weakness may be present bilaterally the treating PT had to evaluate if this component should be applied bilaterally.

Figure 4: *Examples of trunk strength exercise in the HIPARTI rehabilitation program (**appendix 2**)*
(a): Trunk strenght level 1-3, (b): Trunk stenght level 4, (c): Trunk strenght level 9.
Exercises with more than one level listed represents more than one level of exercise due to an increased number of repetions.

4) Functional exercises

The fourth component, functional exercises, included different functional exercises, as well as additional lower limb strength, with different level of progression (level: 1-20 + 4 extra exercises). The functional exercises included components of additional strength, balance, agility and stretching of the mm gastrocnemius and m soleus.

Figure 5: *Examples of functional exercises in the HIPARTI rehabilitation program (**appendix 2**)*
(a): Functunal exercise level 2, (b): Functunal exercise level 10-11, (c): Functional exercise level 14.
Exercises with more than one level listed represents more than one level of exercise due to an increased number of repetions.

5) Cardiovascular training

The fifth component, cardio training, included suggestions of different cardiovascular exercises divided into three different loads (low, medium and high). Each of the progression levels (1-17) were categorized as one of these three different loads as well as being divided into patient choice or sports specific. The last levels in this component included sports specific training to prepare the participant for RTP.

6) Patient Education

The sixth, and last component, patient education, included information and discussion on the following topics; recommended weight loss (if BMI >26), impingement pathology, the participants' expectations and goals and RTP. As a double-blinded study the patient education was conducted accordantly. Information about the surgical procedure, as well as current pathology, was explained to the participant according to the PTs best effort.

4.2.5 Data collection

Data related to the post-operative rehabilitation was collected through two training diaries and one questionnaire developed by the author. The first training diary, the supervised training diary, documented the content of each supervised training sessions (**appendix 4**). The second training diary, the home training diary, documented the content of the participants' home training sessions, as well as all other exercise, and were filled out by the participants each week (**appendix 5**). The questionnaire, the patient education form, documented the participants' education and was filled out by the treating PT continually throughout the rehabilitation as different educational topics were covered (**appendix 6**).

A user-manual on how the participant should fill out the home training diary was written in Norwegian to make the data collection easier for both the treating PT and the participants (**appendix 3**). The user-manual included a list with pictures and instructions of all exercises included in the HIPARTI rehab program. Continuous numbers were used instead of level of progression within each training component to describe each exercise. Illustrations of the initial exercises provided from the operating hospital were also included.

Structure of the HIPARTI rehab program

Supervised training sessions

The time of distribution, content and total number of supervised training sessions each participant received during the rehabilitation period was collected from the participant's supervised training diary.

Home training sessions

The weekly and total number of home training sessions each participant executed during the rehabilitation period were collected from the home training diaries. If the home session was conducted according to the home training program or as a cardiovascular training session was noted, as well as the number of home exercises included in each session.

Content of the HIPARTI rehab program

Rehabilitation components

A detailed description the use of each of the six rehabilitation components for each participant was collected from the training diaries, including if the components were used in supervised or home training sessions. The participants' adherence to the post-operative restrictions was also collected.

Training components included in the home exercise programs

A detailed description of which rehabilitation components the treating PT included in the individual participants' home exercise program was collected from the home training diaries. Exercises the PTs included in addition to the exercises listed in the HIPARTI rehab program was also collected.

Feasibility of the HIPARTI rehab program

Adverse events, compliance, progression of exercise and clinical change were collected from the participants training diaries to evaluate the feasibility of the HIPARTI rehab program for each participant.

Adverse events

Any event that limited the participants' ability to complete training sessions as scheduled, when adjusting for load, were in this study defined as an adverse event. Adverse events could be caused by both internal and external factors, without necessarily being related to the post-operative rehabilitation. Internal factors could be an increase in pain, a decrease in ROM or a tendonitis, while external factors could be an accident or illness during the rehab period. The adverse events were also defined as either minor or major. Minor adverse events were defined as events that limited the participant in their rehabilitation for ≤2 weeks and major adverse events as events that

limited the participant for >2 weeks. All adverse event that were noted in the training diaries were later confirmed by the treating PT.

Compliance

Compliance to the HIPARTI rehab program was based on the total number of home training sessions each participant performed during the rehabilitation period. The participants were defined as compliant if they completed a mean of 2 home training sessions per week.

Progression of exercise

The highest level of exercise in hip strength, trunk strength and functional exercise was used to evaluate the progression of exercise. At any given week, being instructed to execute exercises with at a higher level of than the week before, indicated progression of exercise within that exercise component. Only the level of exercise instructed by the PT was extracted, and the functional exercises marked as "extra", as well any additional exercise not listed in the HIPARTI rehab program, were not included.

Clinical change in hip function and pain

Active hip ROM (AROM) of both limbs in flexion and internal rotation were measured at baseline and follow-up. The hip AROM was measured using an inclinometer, and the average of three trials was recorded. The percentage difference for hip flexion and the values of hip internal rotation on the targeted joint at baseline and follow-up were used to illustrate the clinical change in hip ROM.

International Hip Outcome Tool-33 (IHOT-33) is a PRO consisting of 33 questions, answered with a 10-cm visual analog scale (VAS) grading format (80). The questions are listed under five different categories (hip related symptoms, function, sports, function with occupational activities, and quality of life) and a total score is transformed to 0-100 (worst to best outcome) (80). IHOT-33 is the primary outcome measure in the HIPARI study and has previously been found to have excellent test-retest reliability, acceptable validity and adequate responsiveness (46).

IHOT-33 was answered electronically prior to the baseline assessment and on paper at the follow-up assessment (**appendix 7**). The VAS-scales at follow-up were measured to be 8,6 cm and so two separate researchers had to re-measured and converted the participants answers to fit a 0-100-point scale. A comparison of the total score on IHOT-33 and the score on question 16 on IHOT-33 ("In total, how much pain do you have in your hip/groin?") at baseline and follow-up was used to measure the clinical

change in hip function and pain for each participant. Let it be noted that it was known to the author that using the results from a single question on the IHOT-33 was not a validated method for assessing pain.

4.2.6 Data handling

The data collected from each participant was handled separately with no statistical analyses conducted. Only participant characteristics were summarized by using mean values for age and duration of symptoms.

4.2.7 Ethics

This study was conducted according to the Declaration of Helsinki. Appropriate approval from The Regional Ethical Committee (REK) for South-Eastern Norway was given the HIPARTI-study 07.10.2015 (**appendix 10**). The HIPARTI study is registered in Clinical Trails.gov with number NCT02692807. Prior to inclusion were all patients interested in participating in the study given oral and written information on the potential risks and benefits of participating. The participants were given sufficient time to accept or decline involvement before signing an informed consent (**appendix 11**). All participants could withdraw without giving a reason at any time without affecting their routing care. All surgeons, assessors and treating PTs were registered medical professionals and were bound by confidentiality requirements. Appropriate ethical procedures were followed for all data. Data collection was performed electronically entering the data in the Checkware system (www.checkware.no), approved by the Personvernombud at the OUS. The paper questionnaires from follow-up and the training diaries were stored in binders in a looked storage, where only authorized personnel had access. All personal information was only available to the research team, and stored separately from data to ensure data de-identification.

5.1 Results – part I

This systematic review was conducted according to the PRISMA statement guidelines (74) and a complete PRISMA checklist for our study can be seen in **appendix 8**.

5.1.1 Study selection

A total of 819 studies were identified by the electronic search (**figure 6**). After duplicate removal and title screening, 80 abstracts and/or full-text articles were evaluated for eligibility. Eight studies met the inclusion/exclusion criteria and were included in the systematic review.

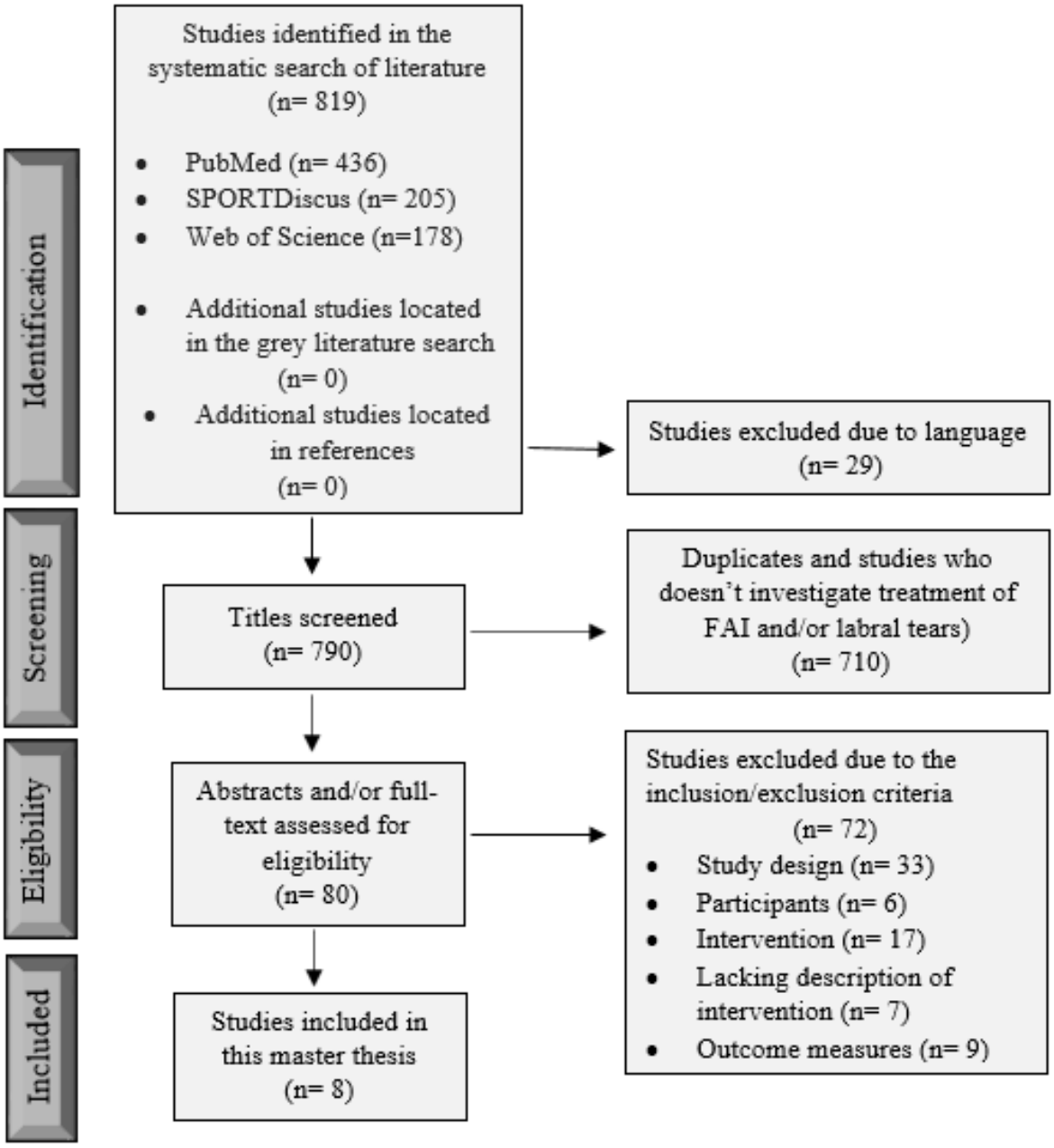

Figure 6: *Flow-chart illustrating the search of literature*

5.1.2 Study characteristics

Individual study characteristics are presented in **table 5**. The eight studies (3 case rapports, 3 case series and 2 pilot-RCT-studies) contained 191 participants in total, and 168 participants when excluding the participants in the two control groups. The participants mean age ranged from 18 to 42 years, with the youngest participant being 15 and the oldest 63 years old. Most participants were women (60,7%).

The participants in the three case reports were diagnosed with both FAI and labral tear (81-83), the participants in two of the case series were diagnosed with FAI and/or labral tear (84, 85) and the participants in the two-pilot-RCT-studies were diagnosed with FAI (86, 87). In the last case series, one participant was diagnosed with pincer FAI, two were diagnosed with labral tear and one was diagnosed with partial labral tear (88).

Seven of the studies confirmed the participants diagnoses using clinical tests and radiographic imaging (81-84, 86-88), while one confirmed the participants diagnoses with morphological findings from arthroscopic surgery (85). The duration of FAI symptoms prior to inclusion varied from 32 days to 3 years, and the time to follow-up varied from 35 days to 12 months.

Four of the studies evaluated hip arthroscopy followed by a post-operative rehabilitation program (81, 83-85) and four evaluated conservative treatment alone (82, 86-88). All studies used physical therapy-led rehabilitation programs, with a variation in duration from five to sixteen weeks.

Table 5: *Characteristics of the included studies*

Author (study)	Design, year	Patient (s)	Diagnostics	Surgical procedure	Rehabilitation and follow-up
Cheatham & Kolber (81)	Prospective case report, 2012	An 18-year-old male high school football player with left hip and groin pain for one year	Left mixed cam-pincer FAI with labral tear confirmed by MRA	Arthroscopic surgery with labral repair	A four-phase rehabilitation program; (1) Initial phase, (2) Intermediate phase, (3) Advanced phase and (4) Sport specific phase Follow-up: 4 months
Dippmann et al. (84)	Prospective case series, 2014	Eighty-seven patients (32 males and 55 females), with a mean age of 38 (range 15-63) years	FAI alone or with labral tear seen on the pre-operative radiographic examination (MRI if needed)	Arthroscopic surgery with labral repair	Post-operative rehabilitation supervised by the local community physical therapist (PTs) the first 8-12 weeks, following a 26-page standardized rehabilitation manual that aims to guide the participants through four phases of rehabilitation Follow-up: 3, 6 and 12 months
Narveson et al. (82)	Prospective case report, 2016	An 18-year-old female involved in horseback riding and her high school track team. She received an intra-articular hip injection 32 days after her injury	Cam FAI and an acute labral tear seen on MRA	Non	An intra-articular hip injection for diagnostic purposes and pain relief and a neuromotor training program over 5 weeks. The program was based on 4 evidence-based phases; (1) Muscular activation/hip corrective strategy, (2) Muscular endurance/static and dynamic postural control, (3) Return to running and skill-specific tasks and (4) Return to sport/polymeric training Follow-ups: At discharge (35 days) and 6 months
Philippon et al. (83)	Prospective case report, 2009	A 25-year-old male football player treated conservatively for 12 months	A right cam FAI with anterior lateral labrum tear confirmed by MRI	Arthroscopic surgery with debridgement and labrum repair	A four phase post-operative rehabilitation program; (1) Mobility and Protection, (2) Stabilization, (3) Strengthening and (4) Return to Sport Follow-up: 9 weeks

(continued)

Author (study)	Design, year	Patient (s)	Diagnostics	Surgical procedure	Rehabilitation and follow-up
Smeatham et al. (87)	RCT pilot study, 2016	In total 30 participants. Intervention group: Fifteen patients (7 male and 8 female) with a mean age of 35,9 (range 18,6-48,8) and a median duration of symptoms of 18 months	Symptomatic FAI based on clinical findings and weight bearing AP pelvis/ lateral hip X-ray	Non	A three-month course of specialized, individually tailored treatment by a PT or routine care. Included components: Assessment and education/advice, hip strengthening, functional and proropseption exercises, core stability exercises, stretches, spinal exercises, manual therapy, gym class, corrective shoe insole and video analysis Follow-up: 3 months
Spencer-Gardner et al. (85)	Retro-spective case series, 2014	Fifty-two patients (19 male and 33 female) with a mean age of 42 (range 16-59 years)	FAI and/or labral tear, diagnosis confirmed by findings in arthroscopic surgery	Arthroscopic surgery with labral debridgement or labrum repair	A five phase post-operative rehabilitation program, different for patients who undergo labral debridgement and for those who have the labrum repaired with a high frequency of PT visits Follow-up: 1 year
Wright et al. (86)	RCT pilot study, 2016	In total 15 participants. Intervention group: Seven patients (3 male and 4 female) with a mean age of 31 years and a duration of symptoms from 6 months to 1 year	FAI diagnosed after a physician-led physical examination complemented by radiography (MRI)	Non	A six-week intervention, randomized to receive either a combination of manual therapy and supervised exercise plus advice and home exercises or advice and home exercises alone. Delivered by licensed PTs trained in the study procedures. Follow-up: 7 weeks
Yazbek et al. (88)	Prospective case series, 2011	Four patients (3 male and 1 female) with a mean age of 24,75 years and a duration of symptoms from 9 months to 3 years	One patient diagnosed with pincer FAI, two with labral tear and one with partial labral tear. Findings seen on MRI	Non	A three-phase conservative treatment protocol consisting of; (1) Pain control, trunk stabilization and correction of abnormal movement, (2) Muscle strengthening and recovery of normal ROM and (3) Sensory motor training and sport-specific functional progression Followed until discharged (9, 12, 13 weeks and 4 months)

5.1.3 Quality assessment

None of the included studies fulfilled all the criteria on the modified Coleman Methodology Score (**appendix 1**), with an average score of 54. The complete scoring for all eight studies can be seen in **table 6**.

Table 6: *Assessment of methodological quality of the included studies using a modified CMS*

Author (study)	Part A							Part B			Total Score
	1	2	3	4	5	6	7	1	2	3	
Cheatham & Kolber (81)	0	0	10	0	5	5	0	2	5	10	37
Dippmann et al. (84)	10	2	10	0	5	5	0	7	15	15	69
Narveson et al. (82)	0	0	10	0	5	5	0	10	11	10	51
Philippon et al. (83)	0	0	10	0	5	5	0	4	5	10	39
Smeatham et al. (87)	0	0	10	15	5	3	0	10	15	15	73
Spencer-Gardner et al. (85)	7	2	10	0	5	5	0	4	10	10	53
Wright et al. (86)	0	0	10	15	5	5	0	10	15	15	75
Yazbek et al. (88)	0	0	10	0	5	5	0	0	5	10	35

The Coleman Methodology Score (CMS) (76) was modified and used to score the methodological quality of the included studies from 0 to 100. The score consisted of two parts, A and B, with different sections in each part.
Part A: 1; Study size, 2; Mean follow-up, 3; Number of interventions, 4; Type of study, 5; Diagnostic certainty; 6: Description of treatment given, 7: Compliance.
Part B: 1; Outcome criteria, 2; Procedure for assessing outcomes, 3; Description of subject selection.

5.1.4 Structure of the rehabilitation programs

Supervised training sessions

Supervised training sessions were reported within the first week of surgery in three of the four post-operative rehabilitation programs (81, 83, 85). Isometric strength exercises of the hip muscles and passive ROM exercises were initiated by the PT within the first day of surgery in Spencer-Gardner et al. (85) and Philippon et al. (83).

The total number of supervised training sessions varied between, and within, all eight studies. In Smeatham et al. (87) the total number of supervised sessions varied between 1 and 13 for the 15 participants during 12 weeks of rehabilitation, while all the participants in Yazbek et al. (88) received 3 sessions per week until discharge. A detailed summary of the number of supervised training sessions can be seen in **table 7**.

Table 7: *A summary of the supervised training session in the included studies*

Author (study)	Number of Supervised training sessions
Cheatham & Kolber (81)	Phase I: 2x per week - following weeks not specified
Dippmann et al. (84)	-
Narveson et al. (82)	A total of 5 treatments during 5 weeks of rehabilitation
Philippon et al. (83)	2x day the first 10 days of rehabilitation – following days not specified
Smeatham et al. (87)	A mean of 6,5 sessions during 3 months of rehabilitation
Spencer-Gardner et al. (85)	Phase I: 1-2 x per week, Phase II: 2x per week, Phase III: 2-3x per week, Phase IV: 1-2x per week
Wright et al. (86)	A total of 12 visits during the 6 weeks of rehabilitation
Yazbek et al. (88)	3 sessions per week until discharged

Home training sessions

Five of the included studies reported using home training sessions (81, 82, 84, 86, 87). Unlike the number of supervises training session, were the number of home training session only specified in Narveson et al. (82). Philippon et al. (83) included a table showing the number of times each of the exercises should be performed per week, but if these exercises were performed with supervision or at home was not described.

5.1.5 Content of the rehabilitation programs

Rehabilitation components

Hip muscle strength was the only rehabilitation component reported in all eight studies. Three different components were used to increase ROM, with the majority of studies using manual treatment. Unlike the other seven studies, kept Smeatham et al. (87) the content of the rehabilitation intentionally open, letting the treating PT decide which components to apply. This resulting in large differences in content between the fifteen included participants (87). A detailed summary of the rehabilitation components reported in the eight rehabilitation programs can be seen in **table 8**.

Table 8: *Rehabilitation components reported in the included studies*

Author (study)	Manual therapy	Hip stretches	ROM exercises [a]	Hip strength*	Trunk strength*	Neuro-muscular*	Functional exercises	Cardio-vascular*	Patient education
Cheatham & Kolber (81)	x	x	x	x	x	x	x	x	
Dippmann et al. (84)	x	x	x	x	x	x	x	x	
Narveson et al. (82)				x	x	x	x	x	
Philippon et al. (83)	x	x	x	x	x	x	x	x	
Smeatham et al. (87)	x	x		x	x	x	x		x
Spencer-Gardner et al. (85)	x	x	x	x	x	x	x	x	x
Wright et al. (86)	x	x		x					x
Yazbek et al. (88)	x		x	x	x	x	x		

a = Passive and active exercises to increase Range of motion (ROM), not including manual therapy or stretches.
*= Exercises to improve hip strength, trunk strength, neuromuscular control and cardiovascular fitness.

Description of exercises components

Six of the studies included tables or an appendix to illustrate and describe the exercises within each exercise component (81, 82, 84-86, 88). Three studies included the number of repetitions and/or series used or recommend for exercises included (82, 84, 88). In addition, two studies included recommended loads for some, but not all exercises (82, 86). Smeatham et al. (87) was the only study with no description of any of the exercise components applied.

5.1.6 Feasibility of the rehabilitation programs

Adverse events

The two pilot RCT's reported that no adverse events occurred during their rehabilitation (86, 87). The remaining six studies did not report adverse events.

Compliance

Compliance was not defined in any of the included studies. Narveson et al. (82) reported that the participant in their study was compliant, but with no further details described.

Progression of exercise

Six studies divided their intervention into three, four or five rehabilitation phases with specific criteria for progressing to the next phase (81-83, 85, 88). A recommended time-line for each phase was described in two studies (81, 85), however phase progression of the individua patients included in Spencer-Gardner et al. (85) was not described.

Phase progression was described in the three case reports (81-83) and for each case in Yazbek et al. (88). **Figure 7** shows how the three participants in the case reports progressed through four phases of rehabilitation before returning to sport, and how the four cases in Yazbek et al. (88) progressed through three phases of rehabilitation before being discharged.

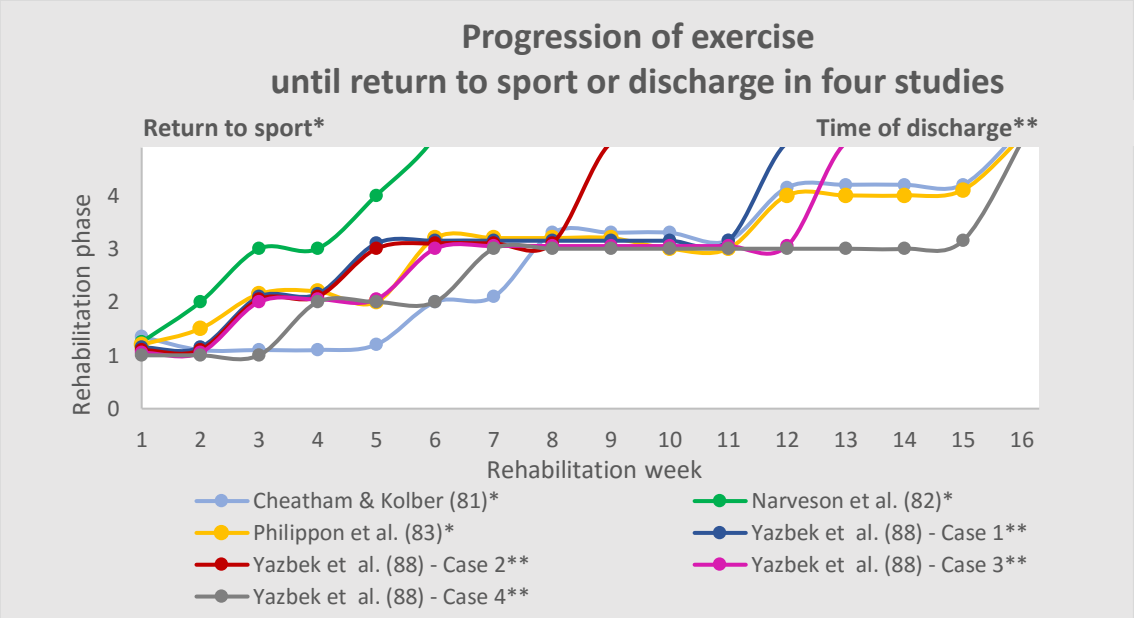

Figure 7: *Progression of exercise, illustrated with progression in rehabilitation phases*
*= Return to play (RTP) used as an end-point of the physical therapy-led rehabilitation. These rehabilitation programs had 4 phases of progression prior to RTP.
** = Time of discharge used as an end-point of the physical therapy-led rehabilitation. The rehabilitation program had 3 phases of progression prior to discharge.

The participant in Narveson et al. (82) progressed quickly and returned to sports after 6 weeks, while the participant in Cheatham & Kolber (81) and Philippon et al. (83) returned to their sport after 16 weeks. The four participants in Yazbek et al. (88) were discharged from the three-phase rehabilitation program after respectively 12 weeks, 9 weeks, 13 weeks and 4 months (16 weeks) of treatment.

The remaining studies did not include a recommended time-line, specific criteria or description of progression for their participants (84, 86, 87).

Clinical changes in hip function and pain

Five studies measured hip ROM at discharge and/or follow-up in at least one plane of motion (81-83, 86, 88). All studies reported of increased and/or normal values of ROM at the time of measurement. Two studies reported the use of electronic devices when measuring hip ROM (82, 83).

The same five studies reported the participants hip muscle strength or increase in hip muscle strength at discharge and/or follow-up (81-83, 86, 88). All studies reported of an increase and/or normal hip muscle strength in the measured planes at the time of measurement. Three studies used handheld dynamometer to measure isometric hip strength (82, 83, 88), while one study used manual muscle tests (0-5) (81). The remaining study did not specify how hip muscle strength was measured (86).

Five studies measure the participants hip related function on PRO's at discharge and/or follow-up (82, 84-87). Two studies used the Modified Harris Hip Scale (mHHS) (84, 85), two studies used LEFS (lower extremity function scale) (86, 87), two studies used the Hip Outcome Score (HOS) for ADL (85, 86), three studies used HOS for sports (85-87) and one study used the IHOT-33 and the PSFS (82). The four studies who compared values at baseline to discharge and/or follow-up, all reported of an increase in the total score (82, 84, 86, 87).

Three studies reported no pain with activities at discharge and/or follow-up (81-83). Four studies reported of a decrease in pain from baseline to discharge and/or follow-ups on an 11 or 101-point VAS or Numeric Pain Rating Scale (NPRS) (84, 86-88).

5.2 Results - part II

This case series was conducted according to the CARE guidelines (89) and a complete CARE checklist for our study can be seen in **appendix 9.**

5.2.1 Participant characteristics

The HIPARTI study started to recruit patients later and slower than expected, hence, the number of subjects in this master thesis were only 3. The first case was operated in May 2016 and the second and third in October 2016. The cases mean age was 35 years, with a mean duration of symptoms of 1,5 years. All three cases had labral tears confirmed by radiographic and surgical findings. Based on the participants' alpha angel, was case II described as having a mild cam-FAI and case III as having a severe cam-FAI by the orthopedic surgeon. Case III was affected bilaterally. Case I and II lived in Oslo, while case III lived 2,5 hour north of Oslo. A summary of the participant characteristics can be seen in **table 9.**

Table 9: *Participant characteristics*

	Case I		**Case II**		**Case III**	
Age, y:	37		28		41	
Gender:	F		F		M	
Hight, m:	1,62		1,82		1,95	
Weight, kg:	65,3		71,6		78,9	
BMI, kg/m2:	24,9		21,5		20,6	
Targeted joint:	Right		Right		Right	
Bilateral problems:	No		No		Yes	
Duration of hip symptoms:	1 year		9 months		3 years and 4 months	
Radiological findings	Targeted joint:	Untargeted joint:	Targeted joint:	Untargeted joint:	Targeted joint:	Untargeted joint:
Alfa-angle:	47°	48°	93°	55°	103°	80°
LCEA*:	30°	32°	32°	30°	28°	26°
Diagnoses:	Labral tear		Mild cam FAI and labral tear		Severe cam FAI and labral tear	
Preferred sports activity and assessed sports level **:	Dance, running and free-weights; level 3		Soccer, volleyball and running; level 5		Cross-country skiing; level 2	

*LCEA: Lateral Center Edge Angle.
**Sports level assessed using the Hip Sport Activity Scale (HSAS).

5.2.2 Structure of the of HIPARTI rehab program

Supervised training sessions

The supervised sessions consisted of a combination of treatment of ROM, performing and adjusting the home exercise program and patient education in all cases. A total of

six, nine and five supervised training sessions were given in case I, II and III. In addition, case I had one session prior to the rehabilitation period. However, as she was not given a home exercise program from the HIPARTI rehab program at that session, the session was excluded from her total number of sessions. The weekly number of supervises training session for each case during the 12 weeks of rehabilitation is illustrated in **figure 8**.

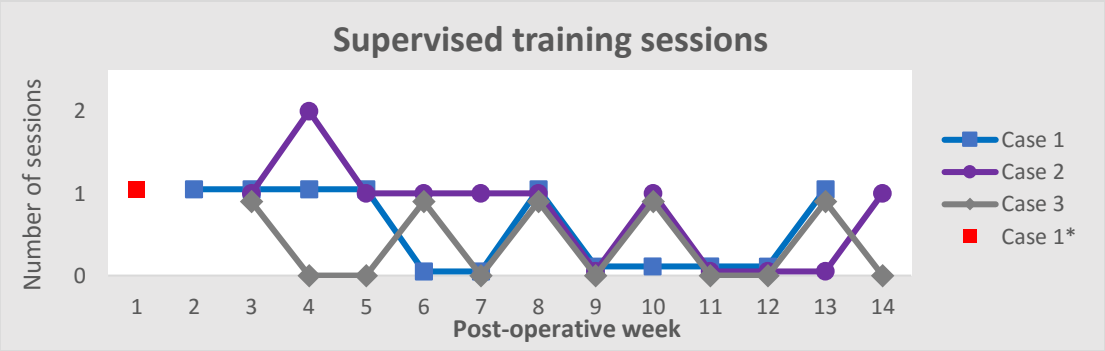

Figure 8: *Supervised training sessions*
*Case I had one supervised session prior to the rehabilitation period. This session was excluded from the total number of sessions.

Home training sessions

Case I executed her first home training session four days after her first supervised training sessions. Half of her home training sessions were performed using her home exercise program and half were executed as cardiovascular training sessions. Case II had her first home training session the same day as she had her first supervised training session. Case III conducted his first home training session 13 days after his first supervised training session. All home training sessions in case II and III were executed using the home exercise program. The number of exercises assigned in the home exercise program varied between five and seven in all three cases. The weekly number of home training sessions for each case during the 12 weeks of rehabilitation weeks is illustrated in **figure 9**.

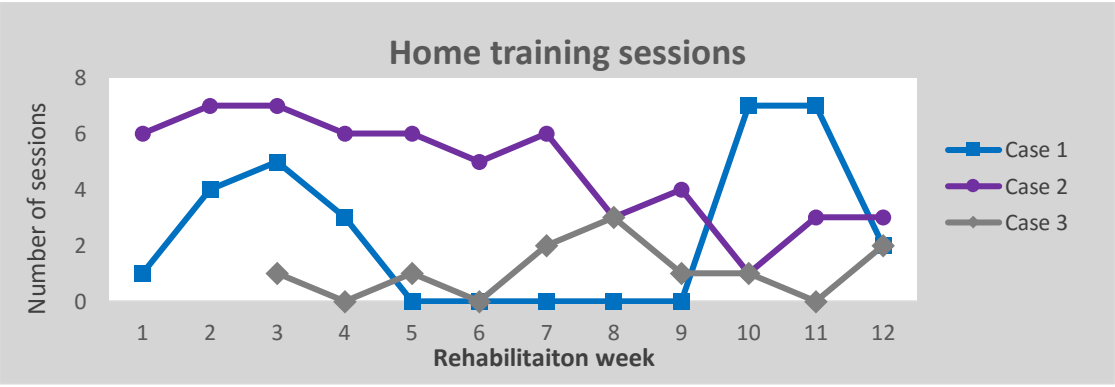

Figure 9: *Home training sessions*

5.2.3 Content of the HIPARTI rehab program

Rehabilitation components

1) Hip range of motion

Case I received passive manual treatment at her second and fifth supervised training sessions to increase hip flexion ROM. At her sixth supervised session hip traction was performed as she was still lacking hip flexion. Case II received trigger point needling in tensor fasciae latae and manual treatment of the hip in her fourth supervised session to optimize the training session. At the ninth supervised session, mobilization of the hip was performed to increase abduction in case II. The treating PT also instructed case II in two home exercises to increase hip rotation as well as different stretches of the hip. In Case III, trigger point treatment was conducted in the psoas muscle at the first supervised session. At the fourth supervised session, pain was experienced at 90° hip flexion and manual treatment techniques were performed in the psoas muscle and groin region in case III.

2) Hip Muscle strength

Hip strength exercises for extension, abduction and/or adduction were included in every assigned home exercise program for all three cases. Unlike the other two, was case II not instructed in any exercises for hip external rotation during the rehabilitation period.

3) Trunk strength

Exercises for trunk strength were included in the home exercise program for all cases during the rehabilitation period. Case I and II were assigned trunk strength exercises the first four and six weeks, while case II was assigned trunk exercises from week eight and throughout the remaining four weeks of the rehabilitation period.

4) Functional exercises

Functional exercises were included in the home exercise program for all cases during the rehabilitation period. Case I and III were assigned functional exercises from the first supervised session, while case II was assigned functional exercises from week four, including an additional exercise for balance. Functional exercises were not assigned between week four and twelve in case I and between week six and twelve in case III. Both cases were re-assigned functional exercises at week twelve.

5) Cardiovascular training

Case I began with 10 minutes of low intensity cardiovascular (cardio) training included in her home exercise program the first rehabilitation week. She gradually increased her

activity level by week four, included more walking in her everyday life, as well as increasing her assigned cardio training to 30 minutes. After a couple of weeks without any cardio training she was assigned 30 minutes of cardiovascular home training in week 10 and 11. At her final supervised session 70 minutes of low intensity cardio training was included in her home exercise program.

Case II completed 20 minutes on a stationary bike every day during the first rehabilitation week. From her second week, stationary bike was included in her home exercise program, and at week three the use of cross-trainer was included. Case II combined the use of stationary bike, cross-trainer and walking uphill on a treadmill, the next couple of weeks. Between week five and ten she returned to only using a stationary bike. At rehabilitation week 10 and 11 she started cross-country skiing, progressing from 30 minutes flat to 90 minutes going up-hill.

Case III reported of 20-30 minute walks his first rehabilitation week. He went cross-country skiing for 30 minutes in his second rehabilitation week. In his third week, he increased hit cross-country skiing to two hours. After a month of no cardio training, he reported of 45 minutes to 1 hour long walks in rehabilitation week nine. No cardio training was assigned in case III.

6) Patient education

All the educational topics listed in the HIPARTI rehab program were covered in the three cases. The primary goal of case I was to be able to exercise and run again, the primary goal of case II was to be able to function in a good and active life and the primary goal for case III was to be able to hike in the summer and cross-country ski in the winter. Case I and II reported use of crutches the first two weeks' post-surgery, while case III reported using crutches only a couple of days' post-surgery. The PT in case III made a note on the patient education form that a lot of time was spent explaining the healing process as well as an expected timeline of recovery.

Exercise components included in the home exercise programs

As mentioned, were the hip strength, trunk strength and functional exercises included in the home exercise program in all three cases. Cardio training was applied in case I and II. In addition, were all three cases assigned other exercises than the once listed in the HIPARTI rehab program. The additional exercise in case I was isometric contractions of the hip extensor muscles the first week of rehabilitation. In case II, additional exercises to increase ROM, stretching of the hip and a balance exercises were. Case III

was given one additional exercise, referred to as “Telemark” by the PT. The exercise was described as a gentler version of functional exercise #40 (**appendix 3**). An illustration of the distribution of assigned exercise in each case can be seen **figure 10**.

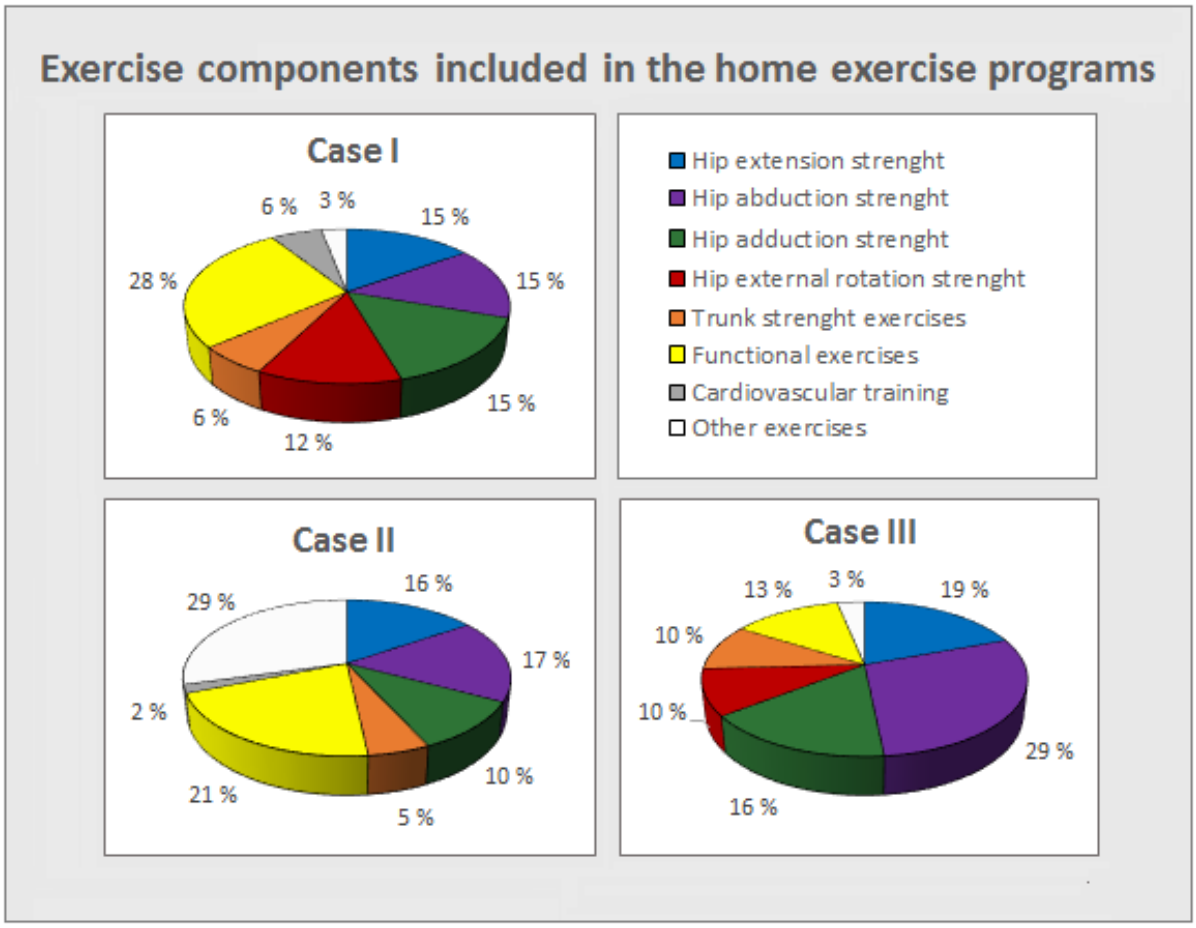

Figure 10: *Exercise components included in home exercise program*

5.2.4 Feasibility of the HIPARTI rehab program

Adverse events

Case I reported increased pain in the hip and groin area at rehabilitation week four. She worked long hours at the time and prolonged sitting increased the pain. The pain kept case I from executing a home exercise program until the last week of rehabilitation. The increase in pain was considered a major adverse event.

Case II had a cold at rehab week 10. The cold preventing her from preforming home exercises as planned that week. The cold was considered a minor adverse event.

Case III reported an overload due to cross-country skiing at rehabilitation week six. The overload was described as very painful, causing the PT in case III to adjust the content

of the home exercise program the following four to five weeks. The increased pain in case III was considered a major adverse event.

Compliance

The average number of home sessions per week was 2,4 in case I, 4,7 in case II and 1,4 in case III (**table 10**). Based on these numbers were case I and II compliant to the HIPARTI rehab program, while case III was found non-compliant.

Table 10: *Training sessions*

	Supervised training sessions	Home training sessions		Total number of training sessions
		HEP	CT	
Case I:	6	14	15	35
Case II:	9	56	0	65
Case III:	5	17	0	22

Number of training sessions for each case during the 12 weeks of rehabilitation. Home training sessions were divided into sessions using a home exercise program (HEP) and sessions with cardiovascular training (CT).

Progression of exercise

Case I started her home exercise program with a variety of hip strength exercises at level 2, as well as functional exercises at level 1. The progression of exercise for all four hip strength muscle groups, trunk strength and functional exercise in case I, showing the highest level of exercise within each component, is illustrated in **figure 11**.

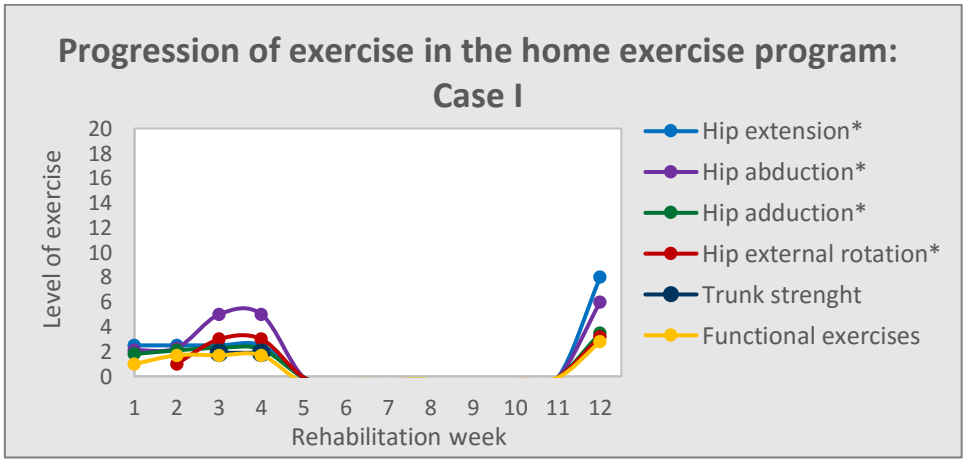

Figure 11: *Progression of exercise case I*
*= Exercises to increase muscle strength in the listed hip muscles

Case II began her home exercises with a variety exercises for hip strength at level 1,2 and 3. Functional exercises were included at week 4 and exercises for trunk strength at week 8. An illustration of the progression, equivalent to **figure 11**, is shown for case II in **figure 12.**

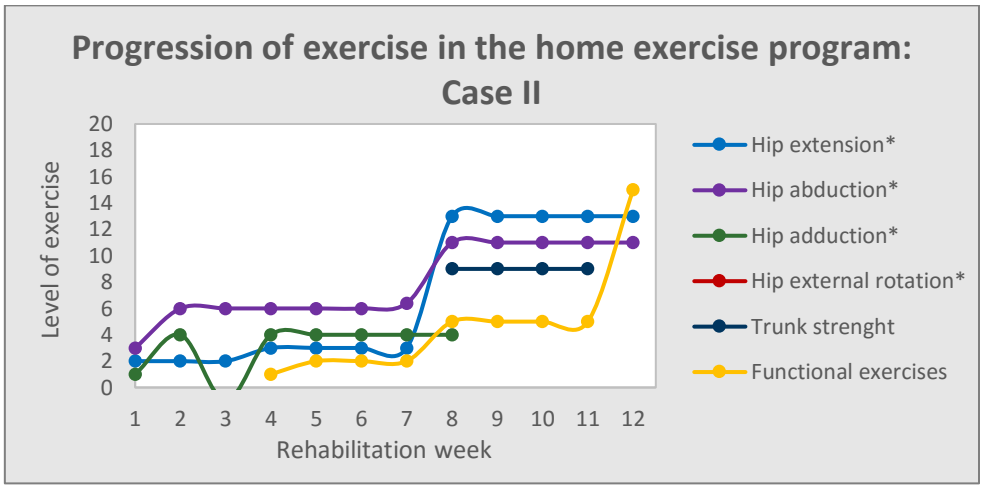

Figure 12: *Progression of exercise case II*
*= Exercises to increase muscle strength in the listed hip muscles.

Case III was assigned hip strength exercises at level 1 to 3, trunk strength at level 4 and functional exercises at level 1 the five weeks. An illustration of the progression, equivalent to **figure 11-12**, is shown for case III in **figure 13.**

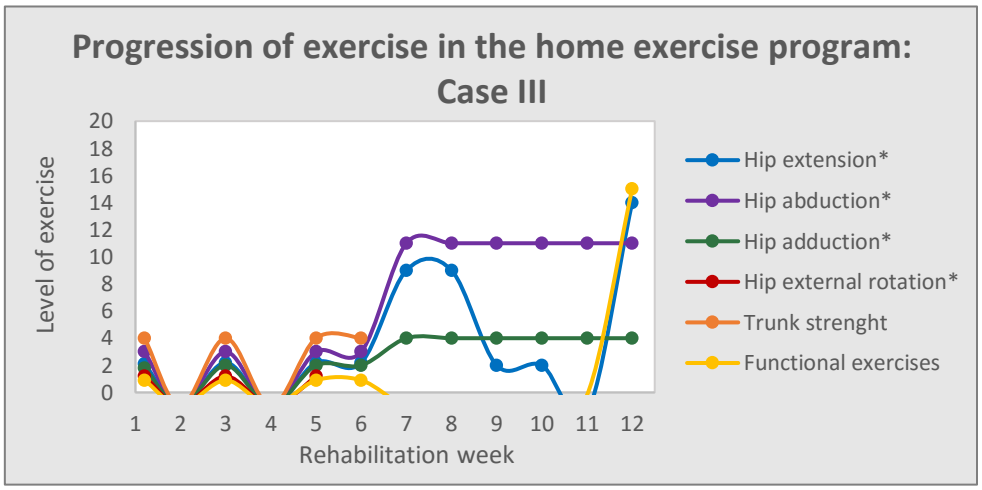

Figure 13: *Progression of exercise case III*
*= Exercises to increase muscle strength in the listed hip muscles

A summary of the final level of progression in the home exercise program for all cases is illustrated in **table 11**.

Table 11: *Highest level of exercise in the home exercise program at rehabilitation week 12*

	Hip extension	Hip abduction	Hip adduction	Hip external rotation	Trunk strength	Functional exercises
Case I	8/14	6/13	3/4	3/3	-	3/20
Case II	13/14	11/13	4/4*	-	9/12	15/20
Case III	14/14	11/13	4/4	-	-	15/20

The highest level of exercise applied in each case/the highest level possible in each exercise component.
*case II reached the last level of hip adduction in rehabilitation week 8.

Clinical change in hip function and pain

Follow-up assessments were performed as planned, three-months post-surgery, in case II and case III. Case I had her follow-up assessment four-months post-surgery.

Hip flexion AROM in the targeted hip decreased with 2,4% in case I, increased with 18,6% in case II and decreased with 3,9% in case III. Hip internal rotation decreased in the targeted hip in all three cases from baseline to follow-up. An illustration of all values of AROM is shown in **table 12**.

Table 12: *Hip active range of motion*

		Flexion		**Internal rotation**	
		Targeted joint:	Untargeted joint:	Targeted joint:	Untargeted joint
Case 1	Baseline:	113°	123°	35°	25°
	Follow-up:	110°	121°	29°	29°
Case 2	Baseline:	104°	113°	36°	29°
	Follow-up:	124°	122°	33°	32°
Case 3	Baseline:	130°	131°	24°	29°
	Follow-up:	125°	133,7°	11,3°	28,7°

The total score on IHOT-33 (80) increased from baseline to follow-up for all three cases. Case I more than doubled her total score, from 18,45 to 43,43 (135% increase), case II increased her total score from 47,37 to 84,06 (77% increase) and case III increased his total score from 60,30 to 66,23 (10% increase) (**figure 14**). The change in hip/groin pain on question 16 on IHOT-33 at baseline and follow-up are also illustrated on **figure 14.**

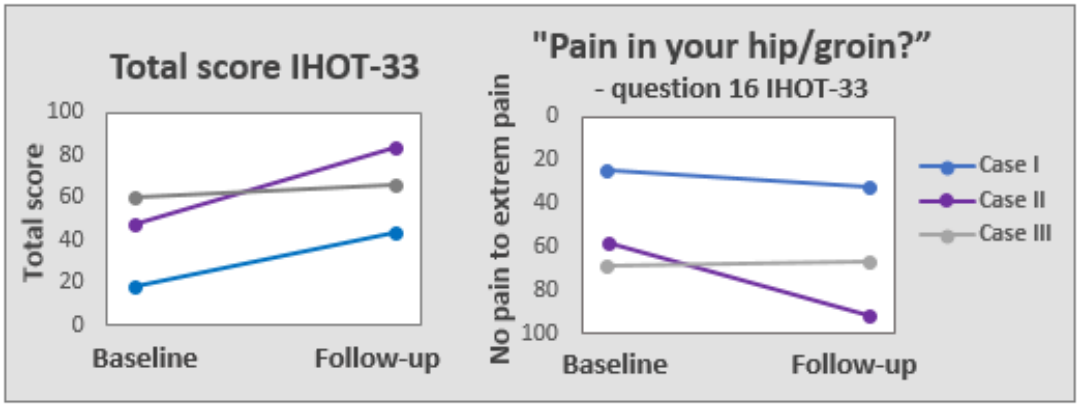

Figure 14: *Total score International Hip Outcome Tool-33 (IHOT-33) and the score on question 16 on IHOT-33 ("In total, how much pain do you have in your hip/groin?") for each case.*

6 Discussion

6.1 Summary of results

Limited literature was identified on physical therapy-led rehabilitation of patients with FAI and/or labral tears. Eight studies met our inclusion criteria and were included in a systematic review. Four of these studies had arthroscopic surgery as part of their intervention. The physical therapy-led rehabilitation programs had similar structure and content as the physical therapy-led rehabilitation program used in the HIPART study (clinicaltrail.gov #NCT02692807).

Supervised training sessions were initiated earlier in the post-operative rehabilitation programs in the systematic review than in HIPARTI. The included studies also reported of a greater number and frequency of supervised sessions than the three cases in HIPARTI. Home training sessions was used in five of the included studies, but a detailed description of home training sessions was lacking in seven of the eight studies. The cases in HIPARTI reported an average of 6,5 supervised trainings sessions and an average of 34 home sessions during the 12-week rehabilitation period.

Six rehabilitation components were included and applied in the HIPARTI rehab program (**appendix 2**). Manual treatment of the hip, hip muscle strength, trunk strength and functional exercises were all included in seven of the studies (81-85, 87-88). Cardiovascular training was included in five of the studies (81-85). Patient education was only reported in three studies (85-87). Additional exercises for ROM, stretches or neuromuscular training were included in seven studies (81-85, 87-88).

The systematic review reported no adverse events and disclosed no data on compliance to the rehabilitation programs. In contrast, were adverse events reported in all cases and compliance to the HIPARTI rehabilitation program was thoroughly described for all cases. Progression of exercise was described through rehabilitation phases in five studies, with progression of exercise reported in all studies and successful RTP in four studies (81-83, 88). Description of the individual progression was missing in the remaining studies. In HIPARTI., the level of progression was evaluated through the level of exercise applied in a home exercise program. The studies included in the systematic review found an increase and/or normal values in all outcome measures for

all participants. Only one case had an increase in all outcome measures at the 3-month follow-up assessment in HIPARTI.
The literature included in the systematic review was assessed to be of an average score of 54. Most studies were case reports or case series and only three studies had a score of ≥69 on a modified Coleman Methodology Score (CMS) (**appendix 1**).

The post-operative rehabilitation program used in the HIPARTI-study was feasible for one of the three included cases. Adverse event occurred in all cases, two cases were compliant and only one participant had progression of exercise in all three exercise components. One case had an improvement in hip flexion ROM at follow-up, but no improvements in internal rotation were found in any of the three cases. All cases had an improvement on IHOT-33, but only two reported a decrease in pain.

6.2 Discussion of results

6.2.1 Physical therapy-led rehabilitation

Structure of the rehabilitation programs

The post-operative rehabilitation of FAI patients is suggested to begin the first week post-surgery (10, 65, 66). In our systematic review, three of the four post-operative studies reported that the rehabilitation was initiated within a week of surgery (81, 83, 85). The HIPARTI rehab program was supposed to be initiated within two weeks of surgery, but was initiated in the third post-operative week for two cases (**figure 8**). Case I had her first supervised session the first week post-surgery, but her 12-week rehabilitation period did not begin until her second week. The first session was excluded from the results as a home exercise program was not provided.

The duration of the rehabilitation programs included in the systematic review ranged from five to sixteen weeks. Most of the rehabilitation programs had the same duration as the 12-week rehab program in HIPARTI. An evaluation of the conservative rehabilitation program used in Emara et al. (55) found 2-3 weeks to be a too short time frame rehabilitation of FAI patients (57). The core study group agreed that a rehabilitation program should be delivered over at least a 12-week period for patients with FAI (57). This statement was supported by established theory, suggesting that physiological changes in muscle occur after a 12-week program of exercise (90). However, while the studies in our systematic review found an improvement on all

outcome measures at discharge and/or follow-up, was 12 weeks a too short time period for detecting clinical change in the HIPARTI study.

The weekly number of supervised training sessions was reported in half the studies in the systematic review (82, 85, 86, 88) (**table 7**). The majority of studies reported one or more supervised sessions per week. Five of the included studies reported using home training sessions (81, 82, 84, 86, 87), but only one study described the number of home sessions (82). Since documentation of home training were lacking it seems likely that the physical therapy-led rehabilitation programs mainly were conducted through supervised training sessions in the systematic review. In our case series, all training sessions were documented. The three cases received an average of less than one supervised sessions per week, with 102 out of the 120 training sessions being home sessions (83,6%). The HIPARTI rehab program was designed as a semi-structural rehabilitation program and the treating PT was the one who decided the number and frequency of supervised training sessions for each participant. While the rehabilitation program in HIPARTI was delivered by independent PTs working in the clinic, was the treating PT in most of the case reports/series directly involved in the studies, with report of an independent researcher (**table 6**). The PTs in the included studies might for that reason have been more invested and able to offer a higher number of supervised training sessions than the PTs in our case series.

The total number of supervised training sessions varied between five and nine in our study (**table 10**). External factors such as travel-distance and time of year might have influenced the difference in number of supervised sessions. Case I was operated in May and summer-break for both the participant and treating PT might have made scheduling supervised sessions more difficult. Case III lived 2,5 hours from the physical therapy clinic of his choice making regular session problematic. Internal factors such as adverse events in case I and III are other possible contributing factors for why they received less supervise sessions than case II.

The current literature does not recommend a specific type of training sessions for patients with FAI. Supervision is important to ensure that compensatory strategies are not adopted (63), but that a homebased rehabilitation program may be adequate if compliance and understanding of progression is present (66). Studies conducted on OA of the knee (91) and low back pain (92) suggest that better outcomes are achieved from

exercise-based regimes when they are supervised. However, a systematic review on knee surgery found that supervision or location does not seem to directly determine the outcome of a rehabilitation program. The same study suggests that variables such as comorbidities and motivation might be greater influencing factors than supervision (93).

Content of the rehabilitation programs

The surgical procedure performed was known prior to initiating the post-operative rehabilitation in the four post-operative rehabilitation programs in the systematic review. It has previous been suggested that effective postoperative rehabilitation for FAI patients must consider modifications specific to the surgical techniques used (Adler et al., 2016). As part of a double-blinded RCT, considering the surgical procedure applied was not possible in our study. However, the HIPARTI rehab program consisted of six key components based on the highest evidence of functional impairments in patients with FAI today (23). Exercises for hip muscle strength, trunk strength, functional performance and cardiovascular training are all frequently used and recommended training components for patients with FAI and/or labral tears (10-13). The six rehabilitation components were also used in three of the physical therapy-led rehabilitation programs in the systematic review (85-87) and the three exercise components (hip strength, trunk strength and functional exercise) were used in seven of the included studies (81-85, 87, 88). These findings suggested that both non-surgical and post-surgical physical therapy-led rehabilitation programs are currently using the same exercise components, regardless of the surgical procedure performed.

The literature proposes the use of exercises such as isometric contractions of the lower extremity, passive and active ROM-exercises and gentle stretching the first week post-surgery (10, 65, 66). The four post-operative rehabilitation programs all described the use of such initial exercises (81, 83-85). The HIPARTI rehab program did not include any initial exercises (**appendix 2**) and providing a home exercise program in case I was not possible at her first session. Excluding the first supervised session in case I and adapting the time of her rehabilitation period instead of including initial exercises might be considered a limitation of the HIPARTI rehab program. However, all three cases were instructed in home exercises the day of surgery at the operating hospital. These exercises were identical to initial exercises listed in Dippmann et al. (84) and were performed until the participants had their first supervised training session. The initial exercises were also included in the Norwegian user manual to assist participants who

needed to perform initial exercises after initiating the HIPARTI rehab program (**appendix 3**).

Diamond et al. (30) stated in 2015 that decreased ROM was the most commonly reported physical limitation for FAI patients in the literature on FAI at the time. The HIPARTI rehab program included several different manual treatment options to facilitate hip flex ROM >116°. These treatment strategies have previously been used with superior effect over exercise therapy for patients with OA (71). Manual treatment techniques were also applied in seven of the included studies (81, 83-88). However, in addition to manual therapy were specific exercises for ROM and/or stretching applied in the systematic review (81-87). These exercises were not included in the HIPARTI rehab program. The HIPARTI rehab program was based on the physical impairments found in Freke et al. (23), and unlike Diamond et al. (30), did Freke et al. (23) not detect a difference in hip ROM between FAI- and control subjects. Freke et al. (23) argues that previous literature is based on limited evidence of low quality and that the high-quality evidence that do exist are not supporting impairments in hip ROM in subjects with FAI. Excessive stretching and conducting ROM exercises with pain have also been suggested to irritate the repaired tissue fallowing surgery and potentially slow down the progression of exercise (69). Nevertheless, hip flexion was decreased in targeted joint in two of the cases in HIPARTI at baseline and as the majority of training sessions were conducted at home, and providing specific home exercises for ROM could potentially have improved the outcomes in our three cases.

Neuromuscular training was reported separately in seven of the rehabilitation programs in the systematic review (81-85, 87, 88) . The same studies included functional exercises. In the HIPARTI rehab program neuromuscular training is included in the functional exercises and listing separate exercises for neuromuscular control was not considered necessary.

The exact content of the home training sessions was decided by the treating PT in our case series. The use of different PTs at different physical therapy clinics could potentially influence differences in the intervention between the participants. However, the PTs were all involved in developing the HIPARTI rehab program and instructed in how to use it prior to the study. They were also given the opportunity to contact the research coordinator or the author of this study if they at any time had any questions or

concerns, minimizing differences in the rehab program. In the majority of the included studies with more than one participant, were different PTs also used to deliver the rehabilitation program (**table 5**) (84-87). Smeatham et al. (87) did intentionally let the treating PT decide the whole content of the rehabilitation program, resulting in major differences between the 15 rehabilitation programs.

An important criterion for all interventions applied in a RCT is that the participants follow the rehabilitation program as it is described in the protocol (94). In our case series, all three PTs found it necessary to give the participants additional exercises than the 50 listed in the HIPARTI rehab program. As no initial exercises were listed, isometric contraction of the hip muscle was applied the first week in case I. Additional exercises represented 29% of the home exercises in case II, making an evaluation of the content of the HIPARTI rehab program difficult, and suggesting that the content might be inadequate. However, the additional exercises given in each case were from different rehabilitation components. This suggests that no specific component was necessarily incomplete. The different exercise components were also applied with a large diversity in the three cases (**figure 10**). The need of adapting the home exercise program to the individual participant support the use of a semi-structured rehabilitation program, such as the HIPARTI rehab program. Additional exercises were not described or documented in any of the studies in the systematic review.

Patient education was only reported in three studies in the systematic review (85-87). Patient education is considered to be the foundation of any rehabilitation program (66) and was one of the six key component in the HIPARTI rehab program. It's important that participants understand the related precautions and the recommended progression for his or her situation (66). Clear guidelines and information regarding the known precautions are considered critical to avoid complications during the rehabilitation (10) and might prevent the occurrence of adverse events.

A detailed description of the content, including pictures, instructions and recommended dose of the exercises applied, was lacking in three of the included studies (83, 87, 88). This makes it difficult for other PTs to follow the suggested programs. Including a comprehensive appendix of the content and exercises applied, like in Dippmann et al. (84), Wright et al. (86) and our case series, might be helpful in the treatment of patients with FAI and or labral tears in everyday clinical practice.

Feasibility of the rehabilitation programs

Adverse events and compliance were not reported in the included studies and a discussion of feasibility between the systematic review and our case series could not be undertaken. However, progression of exercise and clinical improvements seem to be greater in the systematic review than in our case series. As illustrated on **figure 7**, were the participants in four studies either discharged or had reached their final phase at week 12 (81-83, 88) .The timeline in Spencer-Gardner et al. (85) also suggested that the participants should have reached their final phase by week 12. In our case series, none of the three cases were instructed in functional exercises at the highest levels, equivalent to the exercises at phase four or phase of post-operative rehabilitation (**table 1**), at rehabilitation week 12 (**table 11**). These results indicate that the exercise progression was greater in the systematic review than in our case series.

All studies found clinical improvement in all measures of hip function and pain in our systematic review. Despite being measured at different times did five studies find an increase in hip ROM (81-83, 86, 88) and five studies find an improvement on validated PRO's (82, 84-87). In our case series, all cases had an improvement on IHOT-33 (80), but only one case had an improvement in hip flexion ROM and none in hip internal rotation. In addition, did one case report an increase in hip pain. However, the time of measurement was conducted at ≥4 months in two of the four post-operative rehabilitation programs (81, 85) (**table 5**). Post-operative restrictions could potentially delay clinical improvements, making comparing results of the conservative physical-therapy-led programs with follow-up at 3≤ to the results in our case series difficult.

6.2.2 Quality of the included studies

The studies included in our systematic review were assessed to be of an average score of 54 according to a modified CMS (**table 6).** The majority of studies had a small study size, a short time to follow-up, a low-quality study design and did not report or define compliance, resulting in a low score on section A1, A2, A4 and A7 in **PART A** (**table 6**). However, our inclusion criteria ensured that all studies only used one treatment method, had diagnostic certainty for all participants and provide a detailed description of physical therapy-led rehabilitation program. This contributed to a high score for all studies on section A3, A5 and A6 on the modified CMS (**table 6**).

In **part B**, the majority of studies were lacking reliable and sensitive outcome measures and an independent researcher, giving low scores on section B1 and B2. Researches should ideally be independent to avoid inaccurate reporting and bias (76). The CMS was not developed for case reports or case series and the high scores on section B3, description of subject selection, could be misleading. Studies with only one participant would be expected to have a recruitment-rate of>80% and a 100% recruitment, which guarantees a perfect score in most case reports and small case series on B3 (**appendix 1**).

Three studies scored ≥69, which is in the higher end of the scale on CMS. These scores might not be representative results of the methodological quality of these studies, and the weighting of the criteria included in our modified CMS can be questioned. Pilot-RCTs were scored with 15 points, the same score as RCTs, on our modified CMS. Pilot-RCT are not considered to have the same methodological quality as RCTs and a sample size of ≤15 subjects in each group is considered too small to conclude anything about the population in question. Case series are in general considered low quality studies, unable to evaluate any cause-and- effect relationship, and a case series with a score of 69 seem too high even in a prospective study where both intervention and outcomes was satisfyingly described (84). However, the CMS was not designed to evaluate and compare the methodological quality of different interventions (95) and our scores on CMS should not be compared to the results of earlier studies assessed with CMS. The three studies with the highest scores in our systematic review were the three studies with the most comprehensive and detailed methodological description and should for that reason be scored the highest.

The general low quality designs indicated a high risk of bias among the included studies, and so the results of our systematic review should be reviewed with caution. However, let it also be noted that a poor methodical quality does not necessarily mean that the quality of the interventions or the conduct of the trial was poor.

6.2.3 Feasibility of the HIPARTI rehab program

Adverse events, absence of compliance to the HIPARTI rehab program, limited progression of exercise and lack of clinical changes in the two of the three cases made the HIPARTI rehab program only feasible for one case. In this section, the feasibility of the HIPARTI rehab program for each individual case will be discussed.

Case I

The HIPARTI rehab program was not feasible in case I. She experienced a major hip-related adverse event in her fourth rehabilitation week, had a limited progression of exercise in all exercise components and a decrease in hip ROM. The adverse event was an increase in hip pain and was probably the reason for the limited progression of exercise and clinical improvements in hip function. If the adverse event was related to the HIPARTI rehab program, or as she suggested work-related, is unknown. However, following a semi-structured rehabilitation program, her rehabilitation was adapted to her individual needs and a home cardiovascular training program was assigned by the treating PT. As expected did performing a cardiovascular training program not result in substantial progression of exercise in the three exercise components, compliance to the HIPARTI rehab program was achieved as a result.

The clinical changes in hip function were variable in case I. She had a decrease in both hip flexion and internal rotation ROM in her targeted joint (**table 12**), but also the largest increase on IHOT-33 (80) of the three cases. A large limitation in the results of her clinical change was that she was given an additional month to improve. In addition, she had the lowest score on IHOT-33 at baseline and the largest improvement on IHOT-33 was for that reason expected in case I.

Case II

The HIPARTI rehab program was feasible in case II. She only experienced a minor adverse event unrelated to her hip, was compliant to the HIPARTI rehab program, had progression of all three exercise components and had an improvement in both hip flexion ROM and IHOT-33 (80). Compliance to the rehabilitation program has been suggested critical for a patient to achieve a successful outcome (72). Case II preformed 56 home training sessions using the home exercise program, compared to 14 and 17 in case I and III (**table 10**). Case II had in addition the highest number of supervised training session. (**table 10**). A closer monitoring of case II might have influenced her motivation to execute a higher number of home sessions than the other two cases. However, she was very consistent in her training with a high number of home training sessions the whole rehabilitation period. She was also the youngest and most active of the three participants with a score of 5 on HSAS prior to surgery (**table 9**). Exercising 5-7 times per week might not have been such a large life-style change in case II, although this is only a speculation.

Case II was the only case that had progression in all exercise components. The time of implementing the different exercise components was different in case II compared to case I and III. While all three exercise components were included in the first home exercise program in case I and III, was only exercises for hip strength included in case II. Functional exercises were not included until progression was achieved at week 4 in case II. Implementing exercises of the hip prior to trunk and functional exercises are supported by the current literature on post-operative rehabilitation of FAI (10).

Case II was the only case with an improvement in hip flexion ROM. As discussed earlier, were stretching or specific ROM exercises not included in the HIPARTI rehab program. In case II, additional exercises of stretching and ROM were included. However, she did not have an improvement in hip internal rotation, which was the target of the additional ROM home exercise. The high number of other home exercises involving hip flexion could potentially have been a larger contributing factor. She used a stationary bike frequently from the first day of rehabilitation and several functional exercises involving hip flexion, such as squats and Bulgarian launches, was performed in case II (**figure 12, appendix 2**).

Case III

The HIPARTI rehab program was not feasible in case III. He experienced a major hip-related adverse event in his sixth rehabilitation week, was non-compliant to the HIPARTI rehab program, had no progression of exercise in trunk strength and a decrease in both hip ROM and pain. The major adverse event was likely the primary reasons for the lack of feasibility in case III. However, case III was noncompliant to the HIPARTI rehab program even prior to his adverse event and compliance to the rehab program was for that reason not likely regardless of his adverse event.

It is likely that the adverse event occurred due to case III not following the post-operative restrictions (**appendix 2**). By walking without crutches after only a couple of days and performing cardiovascular training at high level only four-weeks post-surgery case III violated at least two of the four post-operative restrictions. Extra time was spent explaining the healing process and expected timeline of recovery in his patient education and case III should probably have accepted more responsibility for his own rehabilitation.

Case III was not given an alternative home training program after his adverse event, but the treating PT did adjust the program down to lower and more appropriate levels of exercise. The progression of exercise was similar in case II and III, with the same level of exercise in several components at week 12 (**table 11**). After his adverse event, no exercises for trunk was included in his home exercise program and progression of trunk strength could for that reason not be evaluated in case III. The high progression of exercise indicates that continuing with an adjusted home exercise program even adverse events occur can result in positive results.

Case III had a decrease in both hip flexion and internal rotation ROM at follow-up. He had improved his score on IHOT-33 (80), but had the smallest improvement. However, with a relatively high score at baseline a small improvement was expected in case III. He also reported of an increase in pain at follow-up. In addition to experience an adverse event early in his rehabilitation period, was case III the only case diagnosed with a severe cam-FAI morphology prior to surgery. If case III received diagnostic surgery, the severe intra-articular pathology must be taken into consideration when evaluating his results.

6.3 Methodology discussion

6.3.1 The systematic review

6.3.1.1 Internal validation

Study design

The first part of our study was designed as systematic review. A systematic review is a review with a clearly formulated research question that uses systematic and explicit methods to identify, select, and critically assess relevant research (74). Unlike in a traditional narrative review, was all relevant literature on physical therapy-led rehabilitation assessed and synthesized in our study (96). A detailed and comprehensive search of litterateur was conducted and the study followed detailed guidelines developed specifically for systematic reviews. The reproducible search strategy and the application of the PRISMA statement (74) are considered the greatest strengths of our systematic review.

Systematic search and inclusion of studies

The PRISMA statement is developed to help authors improve the reporting of systematic reviews (74) and the PRISMA checklist (75) was used as guidelines in all sections of our study. Edibility criteria and data items were specified and listed according to the PICOS-model, as suggested on section 6 and 11 on PRISMA checklist (**appendix 8**). As preliminary searches had revealed, limited literature on physical therapy-led rehabilitation of FAI and/or labra tear patients existed, and so, the search was not limited to studies with a control group or a to specific study design. A wide range in participants age was allowed, only one exercise component had to be included in the intervention and no specific outcome measure had to be applied. No screening of the studies internal and external validity was performed as part of the screening of inclusion process either. The inclusive nature of our study selection minimized the chance of selection bias (96).

The information sources, search and study selection were described and presented, as proposed on section 7-9 on the PRISMA checklist. The search was conducted frequently over a period of three months to make sure that new literature, or literature missed in the original search, would not be unexploited. In addition, grey searches and references were used to widen the search. However, the systematic search was only conducted in three databases and only literature published in Danish, English, Norwegian and Swedish were considered for inclusion. No search of unpublished literature was conducted and no external experts were contacted. The lack of these information sources and search methods might have led to a result where current evidence was not fully represented (97).

Quality assessment

A modified CMS was used to assess the methodological quality of the included studies (**appendix 1**). This made the risk of bias in the individual studies accounted for, as suggested in section 12 and 19 on the PRISMA checklist. Assessing the methodological quality of the studies would also answer the one of the secondary research questions of this master thesis. By using the same methodology score for all studies a comparison of the studies methodological quality was made possible.

The limitations of any systematic review are dependent upon the included studies (67) and the low quality of the included studies is the greatest limitation of our systematic review. All the included studies were either case reports/series and/or had a small study

sample. Our study also lacks an assessment of bias that may affect the cumulative evidence as suggested on section 15 on the PRISMA checklists.

As discussed earlier were three studies with low- to moderate-quality designs scored in the "higher-end" on CMS (84, 86, 87). This indicates that our modified CMS might not have been the ideal tool of assessing the methodological quality in our study and should have been modified further. Also, assessing the quality of the included studies is a subjective process and it is recommended that two different researches score each study independently (97). In our study was the quality assessment only performed by the author.

Data extraction

Summary measures and a synthesis of results was described according to section 13-14 and presented as suggested section 17, 18 and 20 on the PRISMA checklist. The decision to extract the structure and content of the physical therapy-led rehabilitation programs, in addition to adverse events, compliance, progression of exercise and clinical change, was based on the primary aim of this study. Extracting data related to feasibility from studies not evaluating feasibility could potentially led to a lack of findings in the systematic review.

Progression of exercise was evaluated using the predefined rehabilitation phases in the included studies. However, the use of phase progression as a measure of progression of exercise is not very specific. Patients usually progress within each rehabilitation phase and a more detailed description of the content should, if possible, have been extracted.

The clinical change in hip function and pain in the individual studies are not presented for each study as suggested on section 20 on the PRISMA checklist.

Data handling

Due to the lack of comparable study-design and inaccurate outcome measures no meta-analysis or additional analyses could be conducted in our systematic review (97). Additional analyses are suggested on section 14, 16 and 21 on the PRISMA checklist.

The results of single low-quality studies cannot evaluate any cause-and-effect relationship and the results of our systematic review should be reviewed with caution.

6.3.1.2 External validity

The participants' characteristics in our systematic review are similar to the characteristics of the FAI population in general. FAI are most commonly found in the active young or middle-age population (8, 27). In our study the average age ranged from 18 to 42 years in the included studies and all the participants in the included case reports were athletes (81-83). Hip arthroscopic surgery is increasing, especially in the younger population (9), and 83% of the participants included in the systematic review received hip arthroscopic surgery as part of their intervention. All, but one study (88) were conducted in western European countries or in the US. It has been suggested that the prevalence of FAI might be higher in western populations (8).

Cam-type FAI is more common in young men and pincer-type FAI is most common in middle-aged women (8, 21). The majority of included participants with FAI in our systematic review were women, but the type of FAI was not specified in larger studies making it difficult to establish if the gender distribution was representative to the general FAI population.

The participants could be diagnosed with cam-type FAI, pincer-type FAI, mixed-FAI, labral tears or both FAI and labral tears. Patients diagnosed with labral tear, and otherwise healthy joint, may progress much more aggressively during the post-operative rehabilitation than a patient undergoing a more invasive surgical procedure (66). The lack of homogeneity among the included participants might considered a limitation of our study. However, the diversity of the included participants also make the results more generalizing to wider group of patients suffering from intra-articular hip-disorders. In addition, did our study actually have a larger homogeneity than previous reviews on conservative treatment of FAI where all intra-articular hip-disorders have been included (58).

Diagnostic certainty is important when evaluation if an intervention is appropriate for a certain population. All participants included in the systematic review were symptomatic and had their diagnosis confirmed by radiographic and/or surgical findings. This is considered a strength as many individuals may have cam or pincer morphology on radiographs without having FAI (47).

The studies were published during the last eight years, with three studies published in 2016. It is likely that the rehabilitation programs evaluated in our systematic review are

more similar to the current clinical practice in regards of structure and content than pervious reviews, clinical commentaries and research articles. This might give the interventions in our study a greater external validity.

6.3.2 The prospective case series

6.3.2.1 Internal validity

Study design

The second part of our study was designed as a prospective case series. A case report, or case series, is a detailed narrative that describes a medical problem experienced by one or several subjects (89). In our study, a detailed description and evaluation of the post-operative rehabilitation of three subjects with FAI and/or labral tear was conducted. Case reports have previously been proved helpful in the identification of adverse and beneficial effects (89) and could for that reason address the last research question of this master thesis. Feasibility studies can be used to investigate implementation of an intervention and one may ask to what extent a new program successfully can be delivered to the intended participant in some defined, but not fully controlled, context (18).

Case reports can be conducted with both a retrospective and prospective design (97). By following the participants in current time from baseline to follow-up the chance of bias was reduced in our study. The participants documented their training after each session and did not have to recall what exercises or how many sessions they had performed in retrospect. Also, baseline data was collected and compared to follow-up data, making it possible to measure a potential clinical change.

The CARE guidelines (89) was used as guiding principles to make sure that all appropriate sections of a case series were included in our study (**appendix 9**). Without specific guidelines are the results of case reports often difficult to combine for data analysis or guide clinical practice (89).

Inclusion of participants

The patient information and diagnostic assessment, was described according to topic 5 and 8 on the CARE checklist. Specific inclusion and exclusion criteria were followed, and diagnoses were confirmed by the symptoms, clinical signs and radiographic imaging, as suggested by the current literature (1). However, CARE was only used as guidelines and not all sections were covered in our case series. The information from

this case series was not organized into a timeline (topic 7), relevant history (topic 5c-5d), findings from the physical exam (topic 6) and diagnostic challenges (topic 8b) were not presented, and the use of patient perceptive was not found relevant (topic 12). Not including all sections on CARE might be considered a limitation of our case series (**appendix 9**).

Data collection

The HIPARTI rehab program was described in detail, as suggested on topic 9 on the CARE checklist, and a user-manual was developed in Norwegian. The user manual assisted the participants in documenting their home training in the provided training diaries. The cases were asked to note the date every time they performed a home training sessions, as well as note the total number of sessions that week in their home training diary (**appendix 5**). Making the cases double-check the total number of sessions increased the intern validity of the training diaries.

The training diaries were developed by the author of this master thesis, with little experience on data collection prior to the study. The content of the diaries was discussed with the project leader, but the structure and questions were decided by the author. A quality assessment of the training diaries prior to the study could have been favorable as the diaries were missing several important aspects. A weekly pain score, more specific questions related to adverse events and reasons for why the cases performed less than 2 home sessions per week were lacking (**appendix 4**-**5**). Previous feasibility studies have used an online survey (QuestBack Version 9692; QuestBack AS, Oslo, Norway) to further document adherence and occurrence of adverse events (77). A similar survey could have been beneficial in our study. However, this would have required additional approval from REK and was not possible at the time of the study.

Follow-up and outcomes were described, as suggested on topic 10 on the CARE checklist (**appendix 9**). The rehabilitation period was defined as 12 weeks from first home exercise program was given. This ensured that compliance was evaluated fairly in all cases, but also made room for inaccurate times of measurement. Follow-up assessment were scheduled 3-months post-surgery and the three cases could potentially not have completed the 12-week rehabilitation period prior to the follow-up assessment. In addition, was the follow-up assessment conducted at 4-months in one of the cases. These two factors are considered major limitations in the measurements in our study.

Adverse events were used to monitor the tolerances and safety of HIPARTI rehab program. All events that limited the participants' ability to complete training sessions as scheduled was collected. This might have led to including adverse events not relevant to the feasibility of the HIPARTI rehab program. However, it also ensured that no adverse events were missed.

In our study was progression of exercise based on the predefined exercise levels in the HIPARTI rehab program. The highest level of exercise instructed by the PT within each exercise component was extracted. Exercises performed at the participants own initiative at other levels was not extracted. This reduced the chance of bias, as no additional interpretation by the author was necessary when evaluating progression of exercise in our study.

The potential clinical change was measured following a strict and detailed testing protocol. Using electronic devices are suggested to be better than standard goniometry when measuring hip ROM in FAI patients (2). In our study, hip ROM was measured using a handheld inclinometer, and the average of three trials was recorded. Two PTs were present, giving our testing procedure on hip ROM a high intern validity.

The IHOT-33 has been recommended for assessment of young and middle- aged adults with hip related pain, undergone non-surgical treatment or hip arthroscopy (45). The use of a standardized and validated PRO strengthens the internal validity of our study. However, IHOT-33 was answered online at baseline and on paper at follow-up. In addition, was the length of the VAS-scale on the IHOT-33 not standardized at the paper form (**appendix 7**). The author had to measure and recalculate the scores by hand something that potentially could have resulted in error of measurement. The author tried to minimalize the chance of error by having two different subjects measure and calculated the scores.

The decision to use a single question on the IHOT-33 to evaluate pain was considered a limitation of interval validity even prior to conduction the study. Other validated questionnaires should have been used for this purpose.

Data handling

All cases were for evaluated separately in our case series. The size of the study sample will determine the conclusion we can draw from the results (97). The greatest limitation of our case series was the low number of participants included. Statistical analysis could

not be conducted in a study sample of our size and a joint assessment of the feasibility of the HIPARTI rehab program could for that reason not be undertaken.

6.3.2.2 External validity

The patient characteristics of our three cases were similar to the patients' characteristics in our systematic review. This makes the results of our case series generalizing to the general FAI population (6.3.2.2).

The unknown surgical procedure in our case series might make the results of our study difficult to apply in the clinic. However, arthroscopic surgery was performed in all three cases and the HIPARTI rehab program should by all definitions be considered a post-operative rehabilitation program in our study. The results of our case series should for that reason also be considered to have a stronger external validity for surgically treated FAI patients.

Recruitment to the HIPARTI study was done at OUS, which cover a large part of FAI patients from the South- East part of Norway. This area is where most of the Norwegian population lives. That our case series recruited participants from a sample with large heterogeneity is a strength of external validity.

6.4 Summery, clinical implications and further research

To our knowledge, this is the first systematic review on exclusively physical therapy-led rehabilitation program for patients with FAI and/or labral tears. While earlier reviews, clinical comments and research articles have provided general descriptions and recommendations of physical rehabilitation programs, is this the first to summarize structure and content, as well as report adverse events, compliance, exercise progression and clinical change, in the current literature.

A closely monitored physical therapy-led rehabilitation program, both conservative and postoperative, seems to improve the hip ROM, hip strength, hip related quality of life and pain in patients with FAI and/or labral tears in the current literature. Return to play can also be expected within six months of initiating a physical therapy-led rehabilitation program. The rehabilitation programs should include rehabilitation components based on the highest evidence of functional impairments in patients with FAI. This include treatment of ROM, hip strengthening, trunk strengthening, neuromuscular training and functional exercises. Initiating the post-operative rehabilitation early, with exercises for

isometric hip strength and ROM, is suggested. Weekly training sessions with the treating PT are indicated.

The feasibility of physical therapy-led rehabilitation programs for patients with FAI and/or labral tears have only been evaluated in our case series. Our findings indicate that following post-operative restrictions are critical to avoid adverse events and that a strict adherence to the rehabilitation program all twelve weeks are necessary to achieve preferable results.

Treating PTs can use the findings of this study as guidelines when treating patients with FAI and/or labral tears. The methodical quality of both our systematic review and our case series is low, with feasibility only evaluated in three cases. The effect, safety and feasibility of physical therapy-led rehabilitation can for that reason not be determined based on our study.

Future research should be of higher methodological quality, with a larger sample size and a longer time to follow-up. In addition to a detailed description of the rehabilitation components applied, should treatment frequency and type of training sessions be documented in future studies. Feasibility studies should be conducted to determine if the physical therapy-led rehabilitation programs are appropriate for further testing and to identify what in the program needs modification. We recommend that future feasibility studies include a detailed evaluation of adverse events, compliance and exercise progression and clinical changes. If the programs are found to be feasible they should be compared to other rehabilitation programs, as well compared to other treatment strategies in clinical studies with a control group and a randomized controlled design. The HIPARTI study should continue to document adverse events, compliance and exercise progression and clinical changes for all future participants, making a similar feasibility study with a larger study sample and higher methodological quality possible in the future.

7 Conclusion

There is limited evidence on the structure, content and feasibility of physical therapy-led rehabilitation of patients with FAI and/or labral tears. The evidence that does exists report of clinical improvements, but are of low methodical quality and disclose no data on feasibility. A 12-week post-operative rehabilitation program for patients with FAI and/or labral tears was not found feasible in cases where hip-related adverse events occurred, and acquired continuous compliance to be feasible. Larger feasibility studies of higher methodical quality should be conducted on physical therapy-led rehabilitation of patients with FAI and/or labral tears.

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Appendix 1

Modified Coleman Methodology Score

PART A: Only one score to be given for each section				
Section		**Number or factor**	**Score**	**Details**
1	Study size	>60	10	Number of included patients
		41-60	7	
		20-40	4	
		<20, not stated	0	
2	Mean follow-up (months)	>24	5	
		12-24	2	
		<12, not stated or unclear	0	
3	Number of different treatment methods procedures included in each reported outcome	One method	10	Physical therapy-led rehabilitation or arthroscopic surgery followed by physical therapy-led rehabilitation is defined as one method
		More than one method, but >90% of subjects one method	7	
		Not stated, unclear, or <90 % of subjects one method	0	
4	Type of study	Prospective cohort study	15	
		Randomized controlled trial	15	Including pilot-RCT
		Retrospective cohort study	0	
		Case series or case report	0	
5	Diagnostic certainty	In all	5	Clinical signs and radiographic imaging or morphological findings located in arthroscopic surgery
		In >80%	3	
		In <80%	0	
6	Description of treatment given	Adequate (all necessary details given)	5	Description of the physical therapy-led rehabilitation, including type and number of training sessions
		Fair (described, but limited details)	3	
		Inadequate, not stated, or unclear	0	
7	Compliance to the physical therapy-led rehabilitation	Compliance clearly defined with >80% of patients complying	10	
		Compliance clearly defined with 60-80% of patients complying	5	
		Compliance not defined with <60% of patients complying	0	
Score PART A			**/ 60**	

(continued)

PART B – Scores may be given for each option in each of the three sections				
Section		**Number or factor**	**Score**	**Details**
1	Outcome criteria	Outcome measures clearly defined	2	
		Timing of outcome assessment clearly stated	2	
		Use of outcome criteria has reported good reliability	3	Inter-or intrarater reliability tests reported
		Use of outcome with good sensitivity	3	
2	Procedure for assessing outcomes	Subjects recruited (results not taken from patient files)	5	Clinically and radiologically examination
		Independent investigator	4	
		Written assessment	3	Use of Patient Reported Outcomes
		Completion of assessment by subjects themselves with minimal investigator assistance	3	Described that patients have filled out questions themselves
3	Description of subject selection process	Selection criteria reported and unbiased	5	Inclusion criteria clearly reported
		Recruitment rate reported >80 % **or** <80 %	 5 3	Patients returned to follow-up
		Eligible subjects not included in the study satisfactorily accounted for or 100 % recruitment	5	
Score PART B			**/ 40**	

TOTAL SCORE	**/ 100**

Appendix 2

HIPARTI study Rehab Plan

This progressive, semi-standardized rehabilitation program is suitable for pre-operative and post-operative management of patients with FAI. The six components of the rehabilitation program were selected based on current knowledge of the highest level of evidence for physical impairments in FAI. Some exercises within each key component below should be implemented (mandatory), but for many patients not all exercises within each key component would be necessary. The progression within each key component should be tailored to the individual patient.

The six key components targeted in this program include:

1. **ROM (flexion)** *1 stage*
2. **Hip muscle strength (Extension, Abduction, Adduction, External rotation)** *up to 14 stages*
3. **Trunk strength/endurance** *10 stages*
4. **Functional task performance and additional lower limb strength** *20 stages*
5. **Cardiovascular training/load management** *17 stages*
6. **Education**

Each patient will be assessed for each component at the initial visit, starting at level 1.

Each patient will be progressed through each level until highest level of achievement is obtained. That level will form the basis of treatment and home exercise program until the next visit.

This assessment will reoccur at the beginning of each treatment, with the level of achievement used for treatment and home exercise program, until the completion of the program.

A list of possible treatment targets will be provided for each component, and the treating therapist will decide which the most appropriate to use.

Progression to the next level will be determined by successful completion of the previous level, while maintaining VAS <20mm and Borg perceived exertion ≤5 (moderate).

Patients participating in sports activities should be able to successfully complete selected sports specific tests before they are allowed to return to sport. Suggested tests are single-leg hop tests, quadriceps strength tests (1 RM or dynamometer), heel raise test, and the sidehop test. (Note: return to sports criteria after hip arthroscopy have not yet been published.)

Each patient should have 8-12 physical therapy visits (with supervision) including follow-ups during the first 6 months. This will be different between countries, but the least number of visits should be 8 and the maximum during the first 6 months should be 12. Patients experiencing special problems might need more visits, but for patients exceeding 12 visits, reasons must be given. First physical therapy visit should be scheduled within the first 2 weeks post-surgery.

Number of visits (exercise frequencies per week: physical therapy visits + home or individual training sessions), type of exercises, loading and progression should all be recorded (through Physitrack or similar).

Compliance to the exercise therapy program is considered to be a mean of 2 exercise sessions weekly for 6 months.

Postoperative restrictions

- No hip flexion beyond 90° until 2 weeks post-surgery
- Crutches for the first 2 weeks postoperative
- No manual traction for capsular tightness until 12 weeks post-surgery
- No Level 2 cardiovascular exercises until at least 12 weeks post-surgery (this includes running), and level 3 cardiovascular until 6 months post-surgery (this includes football) unless approved by the surgeon

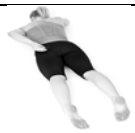
1. Range of Motion

- Flexion ROM checked using inclinometer at each treatment. If <116° or < opposite side, requires treatment.
- Assessed at every treatment session, not treated if ≥116° or same as other side
- Possible targets for treatment
    - Overactive secondary stabilisers (iliopsoas, adductor longus, TFL, gluteus medius, piriformis, rectus femoris, biceps femoris, erector spinae (especially upper lumbar spine). Treatment options – soft tissue techniques; TP release; dry needling or acupuncture; stretching with care to avoid painful impingement positions.
    - Capsular tightness. Assessed using double leg or single leg squat posterior glide of femoral head. Tight if reduced posterior glide compared to other side. Treatment options – manual traction (care with labral repair <3/12 ago, ligamentum teres tear), anterior-posterior gliding mobilisations
    - Bony limitation. Assessed by “hard end feel”, usually in IR@90° flexion or ER@90° flexion. Treatment options – none, treat with respect
    - Weakness hip muscles especially extensors, abductors, adductors, external rotators. Assessment and treatment see below.
    - Pelvic and spinal dysfunction. Assess pelvic symmetry in standing looking at ASIS levels, PSIS levels, and stork test. Assess lumbar ROM in standing. Treatment options – manual therapy to implicated lumbar spine or pelvic regions.

Target for treatment	Assessment method	Technique	Aim	Description	Dosage
Overactive secondary stabilisers	Palpation, pain, reduced ROM	Soft tissue massage and trigger point release of iliopsoas, adductor group, gluteus minimus, gluteus medius, piriformis, tensor fascia latae, erector spinae	Address soft tissue restrictions with the aim of reducing pain and increasing hip joint range of movement	Sustained digital pressure to each trigger point with the muscle positioned on stretch Massage longitudinally along the muscle belly	30-60 seconds digital pressure per trigger point 2-5 minutes of massage per muscle
Lumbar dysfunction	Pain, palpation, ROM	Mobilisation of lumbar spine	To improve lumbar spine mobility and restore normal lumbo-pelvic movement	Unilateral postero-anterior accessory glides, Grade III or IV	3-5 sets of 30-60 seconds
Pelvic and SIJ asymmetries	Pain, palpation, ROM	Correction of sacro-iliac joint asymmetries	To optimise the position of the ilium and therefore the orientation of the acetabulum	Massage to iliopsoas Mobilisation of sacrum	2-5 minutes of massage
Capsular tightness	Palpation of femoral head glide in squat	Manual traction if ligamentum teres is intact or ligated and patient is >3 months post labral repair	Increase hip flexion and/or IR/ER range of motion	Seatbelt around patient's proximal femur and therapist's hips. Gentle inferior and/or lateral traction force applied. May include patient actively moving hip into flexion as traction is applied	3 sets of 10 seconds. If tolerated increase by 1 set per treatment session to a maximum of 6 sets in total
Bony limitations	Hard end feel in ROM tests	None	Treat with respect	None	N/A
Hip muscle weakness	Hand held dymomometry	See section 2	See section 2	See section 2	See section 2

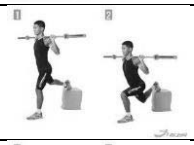
2. Hip muscle strength

- Progression occurs when the previous level is completed successfully, and VAS <20mm and Borg perceived exertion ≤5 (moderate).
- Up to 20 phases of exercise progressions for each muscle group is possible, but not necessarily needed for all patients

Extension			
Phase	**Exercise**	**Description**	**Dosage**
1		Prone Hip extension Gluteal squeeze and leg extension 3-5 second hold and lower	1x10 reps
2		Prone Hip extension Gluteal squeeze and leg extension 3-5 second hold and lower	2x10 reps
7		Prone Hold Hip Extension - knees From knees move affected leg into hip extension 3-5 second hold and lower leg	1x10 reps
8		Prone Hold Hip Extension - knees From knees move affected leg into hip extension 3-5 second hold and lower leg	2x10 reps
9		Prone Hold Hip Extension - knees From knees move affected leg into hip extension 3-5 second hold and lower leg	3x10 reps
10		Prone Hold Hip Extension - toes From toes move affected leg into hip extension 1-5 second hold and lower leg	1x10 reps
11		Prone Hold Hip Extension - toes From toes move affected leg into hip extension 1-5 second hold and lower leg	2x10 reps
12		Prone Hold Hip Extension - toes From toes move affected leg into hip extension 1-5 second hold and lower leg	3x10 reps

13		Windmill: start without resistance (may start using "fingertip touch" to the wall), and progression with therabands under standing foot, held in each hand.	2x6 reps
14		Single leg deadlift with 2kg hand weights held in ipsilateral hand	2x6 reps

Abduction			
Phase	**Exercise**	**Description**	**Dosage**
1		Bridging with band Bridge with band around knees, gently abduct against light band. 3-5 second hold and lower	1x10 reps
2		Bridging with band Bridge with band around knees, gently abduct against light band. 3-5 second hold and lower	2x10 reps
3		Bridging with band Bridge with band around knees, gently abduct against heavy band. 3-5 second hold and lower	3x10 reps
4		Bridge with leg extension and band Start: lift up with two feet on ground, extend one leg then the other then lower with both legs on ground.	1x10 reps
5		Bridge with leg extension and band Start: lift up with two feet on ground, extend one leg then the other then lower with both legs on ground.	2x10 reps
6		Bridge with leg extension and band Progression: extend unaffected knee, lift up using affected side, 2-5 second hold and lower	3x10 reps
7		Bridge with leg extension on unstable surface and band. Extend unaffected knee, lift up using affected side, 2-5 second hold and lower	1x10 reps
8		Bridge with leg extension on unstable surface and band. Extend unaffected knee, lift up using affected side, 2-5 second hold and lower	2x10 reps
9		Bridge with leg extension on unstable surface and band. Extend unaffected knee, lift up using affected side, 2-5 second hold and lower	3x10 reps

10		Side bridge with knee support	1x30 secs each side
11		Side bridge on feet	1x30 secs each side
12		Rearfoot elevated split squat	2x10 reps each side
13		Rearfoot elevated split squat	3x10reps each side, progress w/increased weights

Adduction			
Phase	**Exercise**	**Description**	**Dosage**
1		Bridge, heavy band around thigh pulling out. Lift bottom, hold 3 secs and lower	1x10 reps
2		Bridge, heavy band around thigh pulling out. Lift bottom, hold 3 secs and lower	2x10 reps 3x10 reps
3		Sidebridge, unaffected leg on step, affected leg down, small lift hold 3 secs and lower	1x10 reps 2x10 reps 3x10 reps
4		Exercise with partner or use of a sling or bench with affected leg down. Upper leg in sling/on bench with support at the ankle and knee. Lower bottom leg and hip and return to start position	3x10 reps
4 home		Lie on affected side. Lift top leg up and hold. Keep bottom leg straight and lift it up to meet the top leg. Try to keep pelvis and trunk still.	3x10 reps

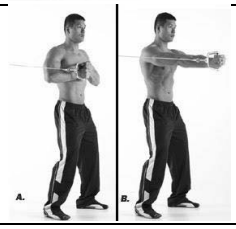
External rotation			
Phase	**Exercise**	**Description**	**Dosage**

1		Four point kneel. Keep foot on ground. Keep trunk stable. Slide to turn foot in against band to neutral rotation. Band = heavy	1x10 reps 3x20 reps
2		Knee standing with one leg in hip and knee flexion in front and the other leg behind trunk with extended hip. Keep trunk stable, keep weight on back foot and slide to turn front foot in against band. Band = heavy	3x10 reps
3		Prone, turn foot in against band. Band = light	3x10 reps
		Prone, turn foot in against band. Band = light	3x15 reps
		Prone, turn foot in against band. Band = medium	3x20 reps

3. Trunk muscle strength

- Weakness may be present bilaterally and if so, should be treated bilaterally.
- Progression occurs when previous level is completed successfully and VAS <20mm
- Twelve levels of exercise progressions are described

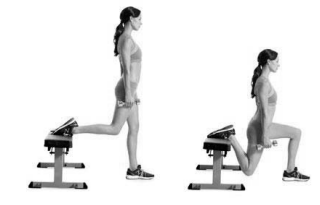
Trunk muscle strength (both sides in all patients)			
Phase	**Exercise**	**Description**	**Dosage**
1		Side bridge	1x30 secs each side
2		Side bridge	1x50 secs each side
3		Side bridge	2x50 secs each side
4		Rotary trunk endurance. Balance on ipsi-lateral knee and hand, extend contra-lateral knee and hand, then	3x8 reps each side

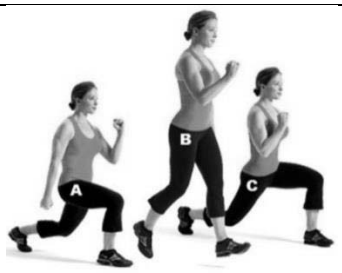
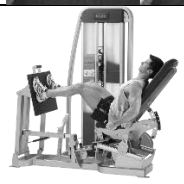
		touch knee to elbow. Progress by adding weights to hand and ankle, increasing sets	
5		Side bridge	2x80 secs each side
6		Side bridge with arm lifts	3x10 reps each side
7		Side bridge with arm reach under then lift (rotate trunk)	3x15 reps each side
8		Side bridge with arm reach under then lift (rotate trunk)	3x20 reps each side
9		Pallof press with heavy band. Progress by standing on unstable surface	3x8 reps
10		Side plank with stability ball. Keep elbow below shoulder. Place one foot in front and one behind on ball.	2x30 reps each side
11		Side plank with stability ball. Keep elbow below shoulder. Place one foot in front and one behind on ball.	2x50 reps each side
12		Side plank with feet on ball, elbow on duradisc. Lift top arm above shoulder, then rotate under trunk.	3x20 reps each side

4. Functional task performance

- Progression occurs when previous level is completed successfully (good control) and VAS <20mm
- 20 levels of progression is described

Functional task			
Phase	**Exercise**	**Description**	**Dosage**
1		Wall Slides with Gluteal Activation. Band around distal thighs. Slide down wall, activate gluteal muscles at 60-90° knee flexion, then push back up into standing	3x10 reps
2		Squats. Flex at hips and squat to comfortable depth, tighten gluteal muscles to return to standing	3x10 reps
3		Squats on BOSU. Flex at hips and squat to comfortable depth, tighten gluteal muscles to return to standing	3x10 reps
4		Assisted step-ups. Affected side on top of step and support with hands. Tighten gluteal muscles and raise knee of unaffected side up above the step.	3x10 reps
5		Step Ups triple extension. Affected side on top of step and support with hands. Tighten gluteal muscles and raise knee of unaffected side up above the step, and extend hip, knee and ankle.	3x10 reps
6		Single Leg Squats Stand on affected side, squat down to comfortable level ensuring adequate hip, knee, ankle alignment. Tighten gluteals to return to standing	3x6 reps, then progress to 3x10 reps
7		Split squat, back foot on bosu.	1x6 reps, then progress 2x6, and then 3x6 reps

8		Windmills	1x6 reps
9		Windmills	1x6 reps with increased speed of movement, then progress 2x6, and then 3x6
10		Jump onto a BOSU/box/step with a double leg landing	3x10 reps
11		Jump onto a BOSU/box/step with single leg landing	3x10 reps
12		Jump down off a BOSU/box/step with a double leg landing	3x10 reps
13		Jump down off a BOSU/box/step with single leg landing	3x10 reps
14		Standing lunges	3x10 reps
15		Bulgarian lunges. Keep one leg behind the trunk, in a flexed resting position on a bench.	3x5 reps

16		Walking lunges	3x10 reps
17		Lunge jump 180°	3x10 reps
18		Sideways sliding	3x10 reps
19		Multidirectional jump double leg	20 reps
20		Multidirectional jump single leg both legs	20 reps
Extra 1		Adjunctive treatment gastroc/soleus stretch on step/against wall	2x60 hold
Extra 1		Leg press, single leg	3x20 reps with light load. Progression: increased load and reduced number of repetitions (3x10 reps --> 3x6 reps)
Extra 2		Heel raise with extended knee	3x10 reps 3x20 reps 3x30 reps

Extra 3		Single leg balance on unstable surface, progress with eyes closed	Up to 2 minutes

5. Cardiovascular fitness/load management

- All patients will be started at level 1 (low load) CV training, tailored to suit individual preferences (weather, equipment, enjoyment, and ultimate goals)
- Level 1 options will include cycling (stationary or road bike, no MTB); swimming (no breast stroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or hiking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer
- All exercise must occur within ROM restrictions for first 6 weeks after surgery.
- Progression occurs when previous level is completed successfully, VAS <20mm and Borg perceived exertion ≤5 (moderate)
- Cannot progress from Level 1 to Level 2 patient choice until phase 6 Level 1 completed; able to complete single leg hop on each leg >65cm; able to complete >16 single leg rises on each leg, and is 3 months post-surgery
- Cannot progress from Level 2 to Level 3 until phase 14 Level 2 completed; able to complete single leg hop on each leg >65cm; able to complete >16 single leg rises on each leg, and is 6 months post-surgery (unless approved by the surgeon)
- Patients will only be progressed to their own individual goal
- Patients with known large cartilage lesions, who wish to progress to running will be educated about the possible risks of this
- 17 levels of CV fitness/loading will be included
- Higher level activity (Level 6 to 14) includes Zumba, running, MTB, athletics, netball, racquet sports, and other sports that are not high impact, pivoting and /or kicking sports
- Highest level activity (Level 15 -17) includes football (all codes), hockey

Cardiovascular training			
Phase	**Exercise**	**Description**	**Dosage**
1	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breastroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or hiking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	10 minutes every second day

2	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breastroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or hiking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	20 minutes every second day
3	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breastroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or hiking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	30 minutes every second day
4	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breastroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or hiking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	30 minutes total, including 5x60 seconds high intensity every second day
5	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breastroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or hiking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	30 minutes including up to 10x60secs or 5x2 minutes high intensity every second day
6	Level 1 patient choice	Cycling (stationary or road bike, no MTB); swimming (no breastroke); other aquatic activity (water aerobics, water jogging no egg beater kick); walking (on flat terrain, no beach or hiking); kayaking; rowing (if flexion ROM >100); elliptical cross trainer.	45 minutes including up to 15 minutes total high intensity every second day
7	Level 2 patient choice= sport specific	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	2 mins every second day (can be combined with 30 mins level 1 activity)
8	Level 2 patient choice= sport specific	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	5 mins every second day (can be combined with 30 mins level 1 activity)
9	Level 2 patient choice= sport specific	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	10 mins every second day (can be combined with 30 mins level 1 activity)
10	Level 2 patient choice= sport specific	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	15 mins every second day (can be combined with 30 mins level 1 activity)
11	Level 2 patient choice	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	20 mins every second day (can be combined with 25 mins level 1 activity)

12	Level 2 patient choice	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	30 mins every second day (can be combined with 20 mins level 1 activity)
13	Level 2 patient choice	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	45 mins every second day, including 10 mins higher intensity (can be combined with 15 mins level 1 activity)
12	Level 2 patient choice	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	50 mins every second day, including 20 minutes high intensity (can be combined with 10 mins level 1 activity).
14	Level 2 patient choice	May include, but not limited to zumba, running, MTB, athletics, netball, racquet sports	Up to 1 hour, 3 time/week, full load
15	Level 3 patient choice	Football codes, and all other high impact pivoting and/or kicking sports	30 mins every second day (can be combined with 20 mins level 1 or 2 activity)
16	Level 3 patient choice	Football codes, and all other high impact pivoting and/or kicking sports	50 mins every second day (can be combined with 20 mins level 1 or 2 activity)
17	Level 3 patient choice	Football codes, and all other high impact pivoting and/or kicking sports	Up to 1 hour, 3 time/week, full load

6. Education (included in the physical therapy visits)

1. Recommended weight loss -if BMI≥26
2. Patients' impingement pathology given from the diagnostic arthroscopy (presence of chondropathy, labral pathology and how it affects outcome).
3. Patients' expectations of treatments
4. Patients' specific goals of treatment and how to most appropriately achieve these.
5. Return to sport, identified using current sporting level on HSAS, and desired sporting level on HSAS, and whether this is possible. Cardiovascular training will be targeted towards this goal.

Appendix 3

Treningsdagbok (øvelsesbank) - HIPARTI

For at vi skal kunne evaluere din rehabilitering best mulig er det viktig at vi får dokumentert alt du gjør av trening og annen fysisk aktivitet i tiden etter operasjonen din.

Du vil av behandlende fysioterapeut få utdelt en treningsdagbok du skal fylle ut når du trener hjemme/uten fysioterapeut. Sammen skal dere fylle ut den øverste tabellen i treningsdagboken («treningsplan frem til neste besøk») på slutten av hvert besøk slik at du som pasient vet hvilke øvelser som skal gjennomføres frem til neste gang du ser din fysioterapeut.

Det er viktig at du fyller ut treningsdagboken hver gang du trener/utfører øvelsene du har fått fra fysioterapeuten din, og i slutten av hver uke noterer ned evt. annen aktivitet du har utført/deltatt i.

Følgende er ønskelig at du notere ned i den utdelte treningsdagboken etter hver trening:

- Dato for den aktuelle treningen
- Treningsnummer til øvelser utført
- Hvor mange repetisjoner og serier du har utført for de ulike øvelsene
- Hvor mye belastning øvelsene ble gjennomført med (evt. om øvelsen ble utført med strikk, i slynge, antall kilo, etc.)
- I hvilken grad øvelsen medførte smerte på en skala fra 0-10

Du vil trolig ikke ha bruk for alle «treningstabellene» i treningsdagboken da de færreste vil trene så mye som syv ganger i uken. Gjør kun det du har blitt enig med din behandlende fysioterapeut om og noter kun ned det du faktisk har gjort.

Behandlende fysioterapeut vil oppbevare en mappe for deg hvor du under hvert besøk skal legge forrige ukes treningsdagbok, samt hente neste ukes treningsdagbok.

Hos behandlende fysioterapeuten vil et annet skjema bli benyttet for å dokumentere behandlingen/treningen som gjøres her (dette skjemaet skal IKKE tas med hjem).

Nedenfor finner du en oversikt over mulige øvelser du som pasient kan gjennomføre under din rehabilitering. Behandlende fysioterapeut vil avgjøre hvilke øvelser som er mest hensiktsmessig å bruke. Øvelsene er nummerert med tallene 1- 50 og inndelt etter ulike treningskomponenter. I tillegg til disse øvelsene kan øvelser du har fått fra sykehuset benyttes de første ukene (# 51-60). Kondisjonstrening er beskrevet med K1-K18. Avtal med din fysioterapeut hvilket nummer som er aktuelt for deg å bruke i treningsdagboken.

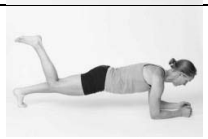
Behandlende fysioterapeut kan i enkelte tilfeller modifisere/tilpasse de ulike øvelsene som er beskrevet her noe. Ved slike tilfeller noteres øvelsesnummeret til den originale øvelsen ned selv om den kanskje ikke utføres helt likt som den er beskrevet.

Øvelser som ikke er beskrevet i programmet, men som behandlende fysioterapeut likevel finner nødvendige, beskrives og nummeres av behandlende fysioterapeut i eget skjema (se siste side). Det er da dette nummeret som skal noteres hvis øvelsen utføres i hjemmet.

Oversikt over øvelser/annen trening:

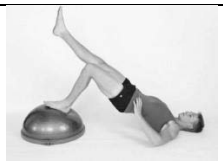
Øvelser for hoftestyrke:

Ekstensjon (utstrekk av hofte):

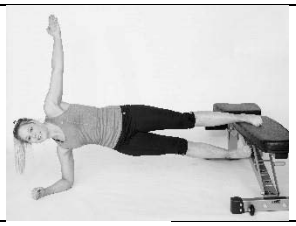
Øvelsesnummer:	Figur:	Beskrivelse:
1		Mageliggende hofteekstensjon: Stram rumpa, hold benet strakt og løft det opp mot taket. Se for deg at helen trekkes oppover. Holdes i 3-5 sek før benet senkes. Pass på at hoftene holdes nede under hele øvelsen.
2		Knestående planke med hofteekstensjon: Løft kneet på det operert benet opp mot taket. Holdes i 3-5 sek før benet senkes.
3		Planke med hofteekstensjon: Bøy kneet på det opererte benet og bruk hoften til å løfte benet opp mot taket. Holdes i 1-5 sek før benet senkes.
4		Vindmølle: Strekk ut bakre ben og len overkroppen fremover for å holde balansen. Start uten motstand (kan starte med å berøre veggen med fingertuppene). Hold kneet stabilt under hele øvelsen. Progresjon: Strikker under standbeinet holdt i hver hånd.
5		Et-bens «markløft»: Hold en håndvekt i motsatt hånd og utfør øvelsen som over.

Abduksjon (utoverføring av hofte):

Øvelsesnummer:	Figur:	Beskrivelse:
6		Bekkenløft med strikk: Løft rumpa opp fra gulvet med begge ben (bekkenløft) med strikk rundt knær, og press forsiktig lårene ut mot strikken. Hold i 3-5 sek og senk.
7		Bekkenløft med ekstensjon av ben: Løft opp rumpa med to ben på bakken, strekk ut ett ben, så det andre, før rumpa senkes med begge ben på bakken. (Kan utføres med strikk som over).
8		Ett-bens bekkenløft med ekstensjon av ben: Strekk ut ikke-operert ben og løft opp rumpa med det opererte benet. Hold i 2-5 sek og senk. (Kan utføres med strikk som over).

9		Bekkenløft med ekstensjon av ben på ustabilt underlag: Strekk ut ikke-operert ben og løft opp rumpa med opererte ben. Hold i 2-5 sek og senk. (Kan utføres med strikk som over).
10		Sideplanke med støtte fra knær: Ligg på siden, ankler/legger samlet oppå hverandre, albue under skulder. Løft hoftepartiet opp fra underlaget. Strak kropp, hold posisjonen.
11		Sideplanke på føtter: Som øvelsen over, men løft også knær opp fra underlaget. Hold posisjonen, strak kropp.
12		Et-bens knebøy med bakre fot hevet: Stå med god avstand mellom fremre og bakre ben, med ikke-operert ben hvilende på en benk. Bøy kneet på det opererte benet slik at hoften faller rett ned mot bakken før du løfter opp igjen. Progresjon: Vekt på skuldre eller i hender

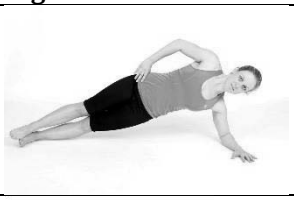
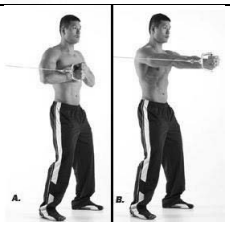
Adduksjon (innoverføring av hofte):

Øvelsesnummer:	**Figur:**	**Beskrivelse:**
13		Bekkenløft med kraftig strikk rundt låret som trekker utover: Løft rumpa opp fra gulvet med begge ben, hold i 3 sek og senk. Sørg for at strikken ikke drar låret utover.
14		Sideplanke på benk: Ligg rett på den opererte siden med det opererte benet nederst, plassert noe foran det ikke-opererte benet. Små løft, hold i 3 sek og senk.
15		Sideplanke med partner, slynge eller benk: Ikke-operert ben øverste i slynge eller på benk med støtte rundt ankel og kne. Senk nederste ben og hofte (operert side) og returner til startposisjonen.
16		Sideliggende hofteadduksjon uten benk: Ligg på operert side. Løft øverste ben opp (ikke-operert) og hold. Hold det nederste benet (operert) strakt og løft det opp for å møte det øverste benet. Prøv å hold bekken og overkropp i ro.

Utoverrotasjon av hofte:

Øvelsesnummer:	Figur:	Beskrivelse:
17		Firebensstående med utoverrotasjon: Strikk rundt helen på det opererte ben. Hold føttene på bakken. Hold overkroppen stabil mens du drar foten innover. Kontrollert bevegelse tilbake til utgangsposisjonen.
18		Knestående utoverrotasjon: Et ben foran kroppen med lett bøy i kne og hofte, mens det andre benet står med strak hofte bak kroppen. Strikk rundt fremre ben. Hold overkroppen stabil, ha vekt på bakre fot og skyv forreste fot innover i motsatt retning av strikken.
19		Mageliggende utoverrotasjon: Strikk rundt operert ben, bøy kne til ca 90° og la strikken rotere benet utover. Hold lårene tett sammen og roter leggen innover slik at den drar imot strikken.

Trunkusstyrke (styrke av kjernemuskulatur):

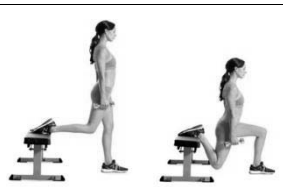
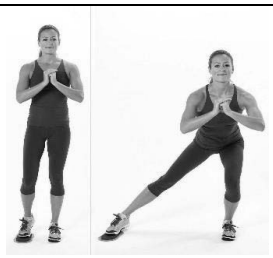
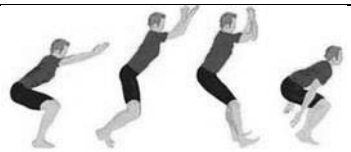
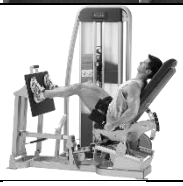
Øvelsesnummer:	Figur:	Bekrivelse:
20		Sideplanke: Som beskrevet tidligere (# 11).
21		Firfotstående diagonalhev: Balanser på motsatt kne og hånd, strekk ut ett ben, før så å berøre kne og albue under overkroppen. Progresjon: Vekter på hånd/ankel
22		Sideplanke med armløft: Sideplanke gjennomføres som tidligere, men nå føres armen opp mot taket samtidig som posisjonen holdes.
23		Sideplanke med rotasjon: Sideplanke gjennomføres som tidligere, men nå berøres gulvet under kroppen med øvre arm før armen løftes opp mot taket (roter overkroppen).
24		«Pallof press»: Stå med skulderbredes avstand, lett bøy i knær, brystet frem og skuldrene tilbake. Strikk festes i veggen og holdes med begge hender tett inntil kroppen. Vend siden mot veggen og strekk ut/press armene fremover. Hold overkropp stabil slik at du holder imot rotasjonen fra strikken.

		Progresjon: Stå på ujevnt underlag
25		Sideplanke på stabilitetsball: Ligg på siden med bena på ballen. Hold albue under skulder. Plasser en fot foran og en bak på ballen og løft hoftene opp så du kommer i en plankeposisjon.
26		Sideplanke med stabilitetsball og balansepute: Sideplanke med føtter på ball og albue på balansepute. Løft øverste arm opp over skulder, før så å rotere den under overkroppen.

Funksjonell trening:

Øvelsesnummer:	Figur:	Beskrivelse:
27		Skli ned vegg: Strikk rundt nederst del av lårene. Skli ned langs veggen og stram rumpa når knærne er bøyd 60-90°, press opp og gå tilbake til stående posisjon.
28		Knebøy: Bøy hoftene og bøy deg ned til komfortabel dybde. Stram rumpa for å returnere til stående posisjon.
29		Knebøy på BOSU: Bøy hoftene og bøy ned til komfortabel dybde. Stram rumpa for å returnere til stående posisjon.
30		Assistert «step-ups»: Stå med operert side på step, støtt med hender. Stram rumpa og løft kneet på ikke-operert side opp over steppen.
31		«Step-ups» med trippel utstrekk: Stå med operert ben på steppen, støtt med hender. Stram rumpa og løft kneet på ikke-operert side opp og over steppen, strekk ut hofte, kne og ankel.
32		Ettbens knebøy: Stå på operert side, bøy ned til komfortabel dybde mens hofte, kne og ankel holdes stabilt. Stram rumpa for å komme tilbake til stående.

33		Utfall på BOSU: Ikke-operert fot hviler bak på BOSU. Stor avstand mellom forreste og bakerste fot. Bøy kneet slik at hoften faller rett ned mot bakken før den føres rett opp igjen.
34		Vindmølle: Som beskrevet tidligere (# 4).
35		Vindmøller med større hastighet: Strekk ut bakre ben og len overkroppen fremover for å holde balansen. Rett deg raskt opp igjen og gjenta. Hold kneet stabilt under hele øvelsen.
36		Hopp opp på BOSU/boks/step med dobbel benlanding:
37		Hopp opp på BOSU/boks/step med ettbenslanding:
38		Hopp ned fra BOSU/boks/step med dobbel benlanding:
39		Hopp ned fra BOSU/boks/step med ettbenslanding:
40		Stående utfall: Hender på hofter mens du tar et stort skritt frem. Kroppen senkes ned mot gulvet ved å bøye kneet slik at låret er parallelt med gulvet. Press opp og tilbake til startposisjon. Ryggen holdes rett.

41		<u>Bulgarske utfall:</u> Et ben hviler på benk bak overkroppen mens det andre bøyes som i øvelsen over.
42		<u>Gående utfall:</u> Som ved stående utfall, men benytt annethvert ben og «gå» fremover.
43		<u>Hoppende utfall 180°:</u> Hopp opp og roter 180° i retning av bakre fot mens du står i «utfall-posisjon». Land med motsatt ben av det du hadde foran, benet skal være bøyd når du lander.
44		<u>Sideveis glid:</u> Ha en sokk eller glatt underlag på det ikke-opererte benet. La foten skli ut til siden mens du bøyer kneet på operert side. Sørg for at kneet beveger seg rett frem over tærne mens helen holdes på bakken. Kontrollert tilbake til utgangsposisjon.
45		<u>Hopp i ulike retninger:</u> Land på to ben. Tær bør være det første som treffer bakken, så heler og bøy av knær. Prøv å ikke rett deg helt opp mellom hvert hopp.
46		<u>Hopp i ulike retninger:</u> Land på ett ben.
47		<u>Strekk av bakside legg:</u> Utføres på step eller opp mot vegg.
48		<u>Benpress, ett-ben:</u>
49		<u>Tåhev med strak knær:</u>

50		<u>Et-bens-balanse på ustabilt underlag:</u> <u>Progresjon:</u> lukkete øyne.

Kondisjonstrening:

Øvelses-nummer:	**Nivå:**	**Beskrivelse:**	**Anbefalt dosering:**
K1	Nivå 1	Sykling (stasjonær eller på vei, ikke terreng); svømming (ikke bryst); andre vannaktiviteter (vannaerobics, vannjogging, ikke trå vannet); gåturer (på flatt underlag, ikke på strand eller fotturer i krevende terreng) kajakk; roing (hvis hoftebøy >100); ellipsemaskin/ crosstrainer.	10 minutter hver andre dag
K2	Nivå 1	- Som øvelse K1	20 minutter hver andre dag
K3	Nivå 1	- Som øvelse K1	30 minutter hver andre dag
K4	Nivå 1	- Som øvelse K1	30 minutter totalt, inkl. 5x60 sekunder med høy intensitet hver andre dag.
K5	Nivå 1	- Som øvelse K1	30 minutter, inkl. opp til 10x60 sekunder eller 5x2 minutter høy intensitet hver andre dag.
K6	Nivå 1	- Som øvelse K1	45 minutter, inkl. opptil 15 minutter total høy intensitet hver andre dag.
K7	Nivå 2	Kan inkludere, men er ikke begrenset til; Zumba, løping, terrengsykkel, friidrett og racketsport.	2 minutter hver andre dag (kan kombineres med 30 min med nivå 1 aktivitet).
K8	Nivå 2	- Som øvelse K7	5 minutter hver andre dag (kan kombineres med 30 min med nivå 1 aktivitet).
K9	Nivå 2	- Som øvelse K7	10 minutter hver andre dag (kan kombineres med 30 min med nivå 1 aktivitet).
K10	Nivå 2	- Som øvelse K7	15 minutter hver andre dag (kan kombineres med 30 min med nivå 1 aktivitet).
K11	Nivå 2	- Som øvelse K7	20 minutter hver andre dag (kan kombineres med 25 min med nivå 1 aktivitet).
K12	Nivå 2	- Som øvelse K7	30 minutter hver andre dag (kan kombineres med 20 min med nivå 1 aktivitet).
K13	Nivå 2	- Som øvelse K7	45 minutter hver andre dag, inkl. 10 min høy intensitet (kan kombineres med 15 min med nivå 1 aktivitet).

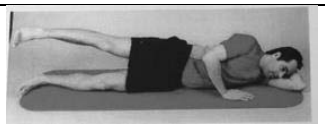
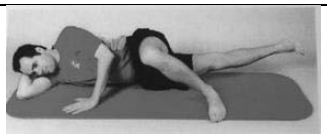
K14	Nivå 2	- Som øvelse K7	50 minutter hver andre dag, inkl. 20 min høy intensitet (kan kombineres med 10 min med nivå 1 aktivitet).
K15	Nivå 3	Fotball og alle andre idretter med høy intensitet, store støt, retningsskift og/eller andre idretter med sparking.	Opptil 1 time, 3 x uken, full belastning.
K16	Nivå 3	- Som øvelse K15	30 minutter hver andre dag (kan kombineres med 20 min nivå 1 eller 2 aktivitet).
K17	Nivå 3	- Som øvelse K15	50 minutter hver andre dag (kan kombineres med 20 min nivå 1 eller 2 aktivitet).
K18	Nivå 3	- Som øvelse K15	Opptil 1 time, 3 x uken, full belastning.

Øvelser fra sykehuset:

- Øvelser som utføres fra første dag:

Øvelsesnummer:	**Figur:**	**Beskrivelse:**	**Dosering:**
51		Beveg opp og ned i anklene, bruk gjerne en pute under leggen.	10 rep x 3 dagen
52		Ligg med strakt ben. Stram muskelaturen på forsiden av låret, hold i noen sekunder	10 rep x 3 dagen
53		Stam sete-muskulaturen, hold noen sekunder og slipp opp igjen.	10 rep x 3 dagen
54		Ligg på ryggen med et bånd eller strikk om foten (evt. plastpose under helen): trekk i båndet og før helen opp mot setet.	10 rep x 3 dagen
55		Kneet på det opererte ben plasseres på en kontorstol. Drei legen sammen med stolen uten å bevege overkroppen, slik at ankelen beveges vekk fra kroppen, deretter mot kroppen.	10 rep x 3 dagen

- Øvelser fra og med andre postoperative uke:

Øvelsesnummer:	Figur:	Beskrivelse:	Dosering:
56		Setet i en behagelig høyde (<90 ° i hoften). Føttene skal peke rett frem. Bruk det friske benet til å kjøre sykkelen. Ingen/lett motstand, hastighet innenfor smertegrensen.	20 min per gang
57		Ligg på ryggen med strake ben. Plasser en strikk rundt lårene. Press benet til siden uten å bevege hoften.	Hold presset i 6 sekunder
58		Ligg på ryggen og før det friske bens kne til brystet. Operert ben skal ligge langs underlaget så du merker et strekk på forsiden av hoften.	Hold strekket i 30 sekunder
59		Ligg på den friske side og gjør deg så lang som mulig. Før det opererte benet opp mot taket.	
60		Ligg på den opererte siden med hoften strakt og det øverste ben bøyd. Løft det nederste benet fra underlaget og opp mot taket.	

Andre øvelser (behandlende fysioterapeut beskriver nye øvelser, samt nummerer dem fra 61 og oppover):

Øvelses-nummer:	Figur:	Beskrivelse:	Dosering:

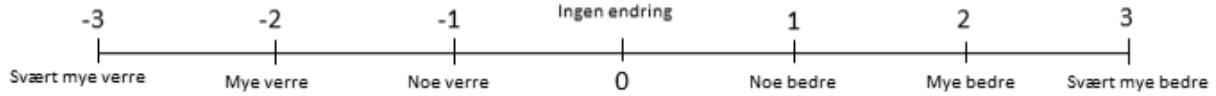
HIPARTI-studien – treningsdagbok (hos fysioterapeut):

Navn: _____ Operasjonsdato: _____ Treningsuke: _____

Fødselsdato: _____ Fysioterapeut: _____ Dato: _____

Hvordan vil du vurdere din hoftefunksjon nå/ i dag sammenlignet med forrige gang du var til fysioterapeuten (antall dager siden: .....):

Kryss av for ett alternativ:



Vurdering av egen hoftefunksjon sammenlignet med ikke-operert side (0-10):

Noe spesielt å bemerke fra denne uken (bruk av medisiner):

Fysioterapeuts vurdering av hoftebevegelse ved dagens besøk (hoftefleksjon <116°):

Beskrivelse av behandling relatert til nedsatt hoftebevegelse under dagens besøk (manuell behandling, nålebehandling, etc.):

Trening/øvelser under dagens besøk:

Øvelses-nummer:	Belastning (antall kg, med strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Annen behandling under dagens besøk (gangtrening, kondisjon, etc.):

Kommentarer til dagens behandling/trening:

Appendix 5

HIPARTI-studien - treningsdagbok (hjemme):

Navn: Treningsuke:

Treningsplan frem til neste besøk (fylles ut av behandlende fysioterapeut):

Øvelses-nummer:	Belastning (antall kg, med strikk, i slynge):	Reps (antall, sekunder):	Serier:	Evt. beskrivelse/figur: (utføres på begge sider?)

Treningsdagbok denne uken (fylles løpende ut av pasienten):

Trening/øvelser – 1. trening						
Dato:	Øvelses-nummer:	Belastning (antall kg, med strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Trening/øvelser – 2. trening						
Dato:	Øvelses-nummer:	Belastning (antall kg, m. strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Trening/øvelser – 3. trening						
Dato:	Øvelses-nummer:	Belastning (antall kg, m. strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Trening/øvelser – 4. trening						
Dato:	Øvelses-nummer:	Belastning (antall kg, m. strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Trening/øvelser – 5. trening						
Dato:	Øvelses-nummer:	Belastning (antall kg, m. strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Trening/øvelser – 6. trening						
Dato:	Øvelses-nummer:	Belastning (antall kg, m. strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Trening/øvelser – 7. trening						
Dato:	Øvelses-nummer:	Belastning (antall kg, m. strikk, i slynge):	Reps (antall, sekunder):	Serier:	Smerter (0-10):	Kommentarer:

Annen aktivitet denne uken:

Type aktivitet:	Beskrivelse:

Andre kommentarer:

Totalt antall treninger (med øvelser fra fysioterapeut) hjemme denne uken: | |

Ved flere enn 7 treninger kan dato for disse treningen noteres her:

Pasientens navn: _____ Operasjonsdato: _____ Behandlende fysioterapeut: _____

HIPARTI-studien – pasientundervisning (hos fysioterapeut):

Beskriv hvorvidt følgende temaer er gjennomgått av den behandlende fysioterapeut i løpet av den postoperative behandlingen:

Tema:	**Temaet er gjennomgått (sett kryss og/eller dato(er)):**	**Eventuelle kommentarer (pasientens forventinger, mål etc.):**	**Ikke aktuelt (sett kryss):**
Anbefalt vekttap (hvis pasienten har en BMI ≥26):			
Beskrivelse av mulig patologi og hvordan denne muligens vil kunne påvirke utfallet av behandlingen:			
Pasientens forventinger til behandlingen:			
Pasientens spesifikke mål for behandlingen og hvordan disse kan oppnås best mulig:			
Tilbakeføring til idrett og ønsket idrettsnivå (ved bruk av HSAS) – kardiovaskulær trening vil rette seg mot dette målet:			
Evt. annen relevant informasjon eller spørsmål pasienten selv har til studien, FAI, den operative behandlingen eller den post-operative rehabiliteringen: • • •			

Appendix 7

IHOT [33] International Hip Outcome Tool

Spørreskjema om livskvalitet for unge, aktive personer med hofteproblemer

Navn: Fødselsdato: Dagens dato:

Hvilken hofte gjelder skjemaet for?

Hvis vi har bedt deg å svare spesifikt om en hofte, kryss av for den. Hvis ikke, kryss av for den du har mest problemer med.

☐ Venstre
☐ Høyre

Instruksjoner

- Disse spørsmålene handler om problemene som du kan oppleve på grunn av hoften din, hvordan disse problemene påvirker livet ditt, samt hvordan du følelsesmessig opplever disse problemene.
- Vennligst indiker alvorlighetsgraden ved å sette en strek på linjen under hvert spørsmål.
  - Hvis du setter streken helt til venstre, betyr det at du opplever betydelige begrensninger. For eksempel:

    BETYDELIG BEGRENSET _____ INGEN PROBLEMER

  - Hvis du setter streken helt til høyre, betyr det at du ikke opplever noen problemer med hoften. For eksempel:

    BETYDELIG BEGRENSET _____ INGEN PROBLEMER

  - Hvis du setter streken midt på linjen, betyr det at du opplever moderate begrensninger, eller, med andre ord, midt mellom ytterpunktene "betydelig begrenset" og "ingen problemer". Det er viktig at du setter streken på en av endene av linjen hvis det beskriver din situasjon best.
- Svar med tanke på den typiske situasjonen den siste måneden.

TIPS: Hvis du ikke gjør aktivitetene beskrevet under, forestill deg hvordan hoften ville kjennes ut hvis du måtte utføre aktiviteten.

DEL 1 SYMPTOMER OG FUNKSJONSBEGRENSNINGER

De følgende spørsmålene handler om symptomer du kan oppleve i hoften, og om hoftens funksjon i daglige aktiviteter. Svar med tanke på hvordan du har følt mesteparten av tiden den siste måneden.

S1 Hvor ofte verker det i hoften/lysken?

HELE TIDEN _____ ALDRI

S2 Hvor stiv blir hoften etter at du har sittet/vært i ro i løpet av dagen?

EKSTREMT STIV _____ IKKE STIV

Oversatt av NOR 2014

S3 Hvor vanskelig er det for deg å gå lengre avstander?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

S4 Hvor mye smerte har du i hoften når du sitter?

EKSTREM SMERTE _____ INGEN SMERTE

S5 Hvor store problemer har du med å stå over en lengre periode?

SVÆRT STORE PROBLEMER _____ INGEN PROBLEMER

S6 Hvor vanskelig er det for deg å komme deg opp fra og ned på gulvet/bakken?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

S7 Hvor vanskelig er det for deg å gå på ujevnt underlag?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

S8 Hvor vanskelig er det for deg å ligge på siden med den affiserte hoften ned?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

S9 Hvor store problemer har du med å gå over hindringer?

SVÆRT STORE PROBLEMER _____ INGEN PROBLEMER

S10 Hvor store problemer har du med å gå opp/ned trapper?

SVÆRT STORE PROBLEMER _____ INGEN PROBLEMER

S11 Hvor store problemer har du med å reise deg fra sittende stilling?

SVÆRT STORE PROBLEMER _____ INGEN PROBLEMER

Oversatt av NKR 2014

S12 Hvor mye ubehag har du hvis du tar lange steg?

EKSTREMT UBEHAG _____ IKKE NOE UBEHAG

S13 Hvor vanskelig er det for deg å gå inn/ut av bilen?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

S14 Hvor store problemer har du med gnissing/ skjæring, låsning eller klikking i hoften?

SVÆRT STORE PROBLEMER _____ INGEN PROBLEMER

S15 Hvor vanskelig er det for deg å ta av/på sokker, strømper eller sko?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

S16 Totalt sett, hvor mye smerte har du hoften/lysken?

EKSTREM SMERTE _____ INGEN SMERTE

DEL 2 IDRETT OG FRITIDSAKTIVITETER

De følgende spørsmålene handler om **hoften** din når du deltar i idrett og fritidsaktiviteter.
Svar med tanke på hvordan du har følt mesteparten av tiden den siste **måneden.**

S17 Hvor bekymret er du for din evne til å opprettholde ditt ønskede aktivitetsnivå?

EKSTREMT BEKYMRET _____ IKKE BEKYMRET

S18 Hvor mye smerte har du i hoften *etter* aktivitet?

EKSTREM SMERTE _____ INGEN SMERTE

S19 Hvor bekymret er du for at smertene i hoften vil øke hvis du deltar i idrett eller fritidsaktiviteter?

EKSTREMT BEKYMRET _____ IKKE BEKYMRET

Oversatt av NKR 2014

S20 Hvor mye har livskvaliteten blitt redusert fordi du ikke kan delta i idrett/fritidsaktiviteter?

EKSTREMT REDUSERT _____ IKKE REDUSERT

S21 Hvor bekymret er du for å utføre vendinger/retningsendringer under sportslige aktiviteter?

☐ Jeg gjør ikke denne typen aktivitet

EKSTREMT BEKYMRET _____ IKKE BEKYMRET

S22 Hvor mye er prestasjonsnivået ditt blitt redusert i idrett eller fritidsaktivitet?

EKSTREMT REDUSERT _____ IKKE REDUSERT

DEL 3 ARBEIDSRELATERTE UTFORDRINGER

De følgende spørsmålene handler om hoften din med tanke på nåværende arbeidssituasjon.

Svar med tanke på hvordan du har følt mesteparten av tiden den siste måneden.

☐ Jeg er ikke i jobb, på grunn av hoften min (hopp over denne delen)

☐ Jeg er ikke i jobb, men av andre grunner enn hoften min (hopp over denne delen)

S23 Hvor store problemer har du når du dytter, drar, løfter eller bærer tunge gjenstander på jobb?

☐ Jeg gjør ikke denne typen aktivitet

ALVORLIGE PROBLEMER _____ INGEN PROBLEMER

S24 Hvor store problemer har du med å sette deg på huk og reise deg opp igjen?

SVÆRT STORE PROBLEMER _____ INGEN PROBLEMER

S25 Hvor bekymret er du for at din arbeidsaktivitet vil gjøre hoften verre?

EKSTREMT BEKYMRET _____ IKKE BEKYMRET

S26 Hvor vanskelig er det å utføre jobben din på grunn av redusert bevegelighet i hoften?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

Oversatt av NKR 2014

DEL 4 SOSIALE, FØLELSESMESSIGE OG LIVSSTILSUTFORDRINGER

De følgende spørsmålene handler om sosiale, følelsesmessige og livsstilsutfordringer du kan oppleve på grunn av hofteplagene. Svar med tanke på hvordan du har følt mesteparten av tiden den siste måneden.

S27 Hvor frustrert er du på grunn av hofteplagene dine?

EKSTREMT FRUSTRERT _____ IKKE FRUSTRERT

Q28 Hvor store problemer har du med seksuell aktivitet på grunn av hoften?

☐ Dette er ikke relevant for meg

ALVORLIGE PROBLEMER _____ INGEN PROBLEMER

Q29 Hvor forstyrrende er dine hofteproblemer?

EKSTREMT FORSTYRRENDE _____ IKKE FORSTYRRENDE

S30 Hvor vanskelig er det for deg å bli kvitt spenninger og stress på grunn av hofteplagene dine?

EKSTREMT VANSKELIG _____ IKKE VANSKELIG

S31 Hvor motløs er du på grunn av hofteplagene dine?

EKSTREMT MOTLØS _____ IKKE MOTLØS

S32 Hvor bekymret er du for å løfte eller bære barn på grunn av hoften?

☐ Dette er ikke relevant for meg

EKSTREMT BEKYMRET _____ IKKE BEKYMRET

S33 Hvor ofte tenker du over hofteproblemene dine?

HELE TIDEN _____ ALDRI

Oversatt av NOR 2014

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	**0**
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	**i**
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	**1**
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	**4**
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	**-**
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	**22**
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	**21**
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	**21**
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	**22**
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	**23**
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	**21**
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	**22**
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	**-**
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	**25**

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	-
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	-
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	**35**
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	**37**
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	**39**
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	-
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	-
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	-
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	-
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	**52**
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	**62**
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	**71**
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	-

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: **www.prisma-statement.org**.

Appendix 9

CARE Checklist (2013) of information to include when writing a case report

Topic	Item	Checklist item description	Reported on Page
Title	1	The words "case report" should be in the title along with the area of focus	0
Key Words	2	2 to 5 key words that identify areas covered in this case report	i
Abstract	3a	Introduction—What is unique about this case? What does it add to the medical literature?	i
	3b	The main symptoms of the patient and the important clinical findings	i
	3c	The main diagnoses, therapeutics interventions, and outcomes	i
	3d	Conclusion—What are the main "take-away" lessons from this case?	i
Introduction	4	One or two paragraphs summarizing why this case is unique with references	2
Patient Information	5a	De-identified demographic information and other patient specific information	44
	5b	Main concerns and symptoms of the patient	26
	5c	Medical, family, and psychosocial history including relevant genetic information (also see timeline)	X
	5d	Relevant past interventions and their outcomes	X
Clinical Findings	6	Describe the relevant physical examination (PE) and other significant clinical findings	X
Timeline	7	Important information from the patient's history organized as a timeline	X
Diagnostic Assessment	8a	Diagnostic methods (such as PE, laboratory testing, imaging, surveys)	26
	8b	Diagnostic challenges (such as access, financial, or cultural)	X
	8c	Diagnostic reasoning including other diagnoses considered	26
	8d	Prognostic characteristics (such as staging in oncology) where applicable	44
Therapeutic Intervention	9a	Types of intervention (such as pharmacologic, surgical, preventive, self-care)	28
	9b	Administration of intervention (such as dosage, strength, duration)	45
	9c	Changes in intervention (with rationale)	47
Follow-up and Outcomes	10a	Clinician and patient-assessed outcomes (when appropriate)	51
	10b	Important follow-up diagnostic and other test results	X
	10c	Intervention adherence and tolerability (How was this assessed?)	49
	10d	Adverse and unanticipated events	48
Discussion	11a	Discussion of the strengths and limitations in your approach to this case	66
	11b	Discussion of the relevant medical literature	53
	11c	The rationale for conclusions (including assessment of possible causes)	70
	11d	The primary "take-away" lessons of this case report	71
Patient Perspective	12	When appropriate the patient should share their perspective on the treatments they received	X
Informed Consent	13	Did the patient give informed consent? Please provide if requested	Yes ☑ No ☐

Appendix 10

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Silje U. Lauvrak	22845520	07.10.2015	2015/1576

REK sør-øst D

Deres dato:	Deres referanse:
18.08.2015	

Vår referanse må oppgis ved alle henvendelser

May Arna Risberg
Oslo universitetssykehus HF

2015/1576 Kirurgisk behandling versus diagnostisk artroskopi for pasienter som vurderes som kasus for hofteartroskopi

Forskningsansvarlig: Oslo universitetssykehus HF
Prosjektleder: May Arna Risberg

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst D) i møtet 16.09.2015. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10, jf. forskningsetikkloven § 4.

Prosjektleders prosjektbeskrivelse
Antall hofteartroskopier har økt eksponensielt de siste årene. Til tross for at denne typen inngrep nå er svært vanlig, er det fremdeles ikke gjennomført noen randomiserte kontrollerte studier på effekt av hofteartroskopi for femoroecetabular impingement (FAI) og labrumskade. Målet med denne studien er å evaluere effekt av kirurgi for FAI sammenlignet med sham kirurgi på smerte og funksjon. 140 pasienter som er kandidater for hofteartroskopi inkluderes i en internasjonal multisenter studie og randomiseres til kirurgisk behandling eller sham kirurgi (kun diagnostisk hofteartroskopi). Studen er dobbelt blindet og hovedendepunktet er et validert pasientrapportert utfallsmål (iHOT) 1 år etter inklusjon. Alle pasienter følges 6 måneder, 1 år, 2 år og 5 og10 år etter kirurgi, også for å inkludere effekt av langtidsresultater på hofteartrosutvikling.

Vurdering
Formålet med prosjektet er å evaluere effekt av artroskopisk kirurgi for FAI sammenlignet med sham (kun diagnostisk) kirurgi på smerte og funksjon. Hypotesen er at aktiv kirurgi er best. Artroskopi er et svært vanlig inngrep, men det er fremdeles ikke gjennomført noen randomiserte kontrollerte studier på effekt av hofteartroskopi for FAI og labrumskade. På denne bakgrunn mener komiteen at den omsøkte studien er viktig, da man for fremtidige pasienter kan unngå å gjøre inngrep dersom resultatene skulle tilsi at artroskopi ikke gir gevinst.

Det skal i prosjektet inkluderes pasienter som er henvist til artroskopi. Komiteens vurdering er at deltagerne vil kunne ha fordel av å delta i form av tettere oppfølging enn vanlig. Alle deltagerne vil også gjennomgå et

3 måneders rehabiliteringsprogram etter kirurgi. For pasientene som trekkes til den diagnostiske kikkehullsgruppen, kan det være en ulempe at det ikke gjøres ytterligere kirurgiske inngrep. Etter komiteens syn kommer imidlertid dette tydelig frem i informasjonsskrivet, slik at deltagerne vet hva de eventuelt samtykker til. Det er også lagt opp til god beredskap i prosjektet, ved at pasienter som trekkes til den diagnostiske kikkehullsgruppen, og der kirurgen skulle finne noe som han/hun mener må behandles, vil bli ekskludert fra studien og behandlet. Dette kommer også klart frem i informasjonen til deltagerne.

Besøksadresse:
Gullhaugveien 1-3, 0484 Oslo

Telefon: 22845511
E-post: post@helseforskning.etikkom.no
Web: http://helseforskning.etikkom.no/

All post og e-post som inngår i saksbehandlingen, bes adressert til REK sør-øst og ikke til enkelte personer

Kindly address all mail and e-mails to the Regional Ethics Committee, REK sør-øst, not to individual staff

Etter en helhetlig vurdering har komiteen kommet til at studien er forsvarlig å gjennomføre som beskrevet i søknad og protokoll.

Vedtak

Med hjemmel i helseforskningsloven § 9 jf. 33 godkjenner komiteen at prosjektet gjennomføres.

Godkjenningen er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad og protokoll, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Tillatelsen gjelder til 31.08.2020. Av dokumentasjonshensyn skal opplysningene likevel bevares inntil
31.08.2025. Forskningsfilen skal oppbevares avidentifisert, dvs. atskilt i en nøkkel- og en opplysningsfil. Opplysningene skal deretter slettes eller anonymiseres, senest innen et halvt år fra denne dato.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriften kapittel 2, og Helsedirektoratets veileder for «Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse og omsorgssektoren».

Dersom det skal gjøres vesentlige endringer i prosjektet i forhold til de opplysninger som er gitt i søknaden, må prosjektleder sende endringsmelding til REK.

Prosjektet skal sende sluttmelding på eget skjema, senest et halvt år etter prosjektslutt.

Klageadgang
REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst D. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst D, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Vi ber om at alle henvendelser sendes inn på korrekt skjema via vår saksportal:

http://helseforskning.etikkom.no. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: post@helseforskning.etikkom.no.

Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Finn Wisløff
Professor em. dr. med.
Leder

Silje U. Lauvrak
Rådgiver

Kopi til: lars.nordsletten@medisin.uio.no
Oslo universitetssykehus HF ved øverste administrative ledelse:
oushfdlgodkjenning@ous-hf.no

Appendix 11

Forespørsel om deltakelse i forskningsprosjektet

"Kirurgisk behandling versus diagnostisk artroskopi for pasienter som vurderes som kasus for hofteartroskopi"

Bakgrunn og hensikt
Dette er et spørsmål til deg om å delta i en forskningsstudie der vi skal teste den kirurgiske metoden som ofte gjennomføres hos dere som har fått diagnosen impingement i hoften (inneklemmingssyndrom, FAI) og/eller labrum skade (bindevevsringen, «leppen», rundt hofteledd).

Dette er en internasjonal studie der flere kliniske forskningsmiljøer er med fra Australia, Canada, Storbritannia, Danmark og Sverige. Hovedsenteret for studien er Ortopedisk avdeling, Oslo Universitetssykehus.

Dette inngrepet gjennomføres med såkalt kikkehullsmetode (artroskopi) (gjelder for alle pasienter i studien). Det er en kirurgisk metode som blir stadig vanligere å bruke på pasienter med smerter i hoften der man antar at smertene forårsakes av et inneklemmingssyndrom (FAI). Fram til nå er det ikke vist at hofteartroskopi med denne type kirurgi er bedre enn en annen behandling eller ingen reell behandling (placebo-behandling). Det er heller ingen god forskning som viser at en operasjon forhindrer utvikling av artrose (slitasjegikt) i hoften. Videre vet man lite om hva som egentlig forårsaker smertene.
Denne studien er utformet for å kunne vurdere om kirurgisk behandling er bedre enn diagnostisk artroskopi i forhold til redusert smerte og bedret funksjon for denne pasientgruppen. Mange pasienter med denne type hoftesmerter har prøvd fysioterapi og trening før man er blitt henvist til kirurgi. Heller ikke innenfor fysioterapi og trening har man noen forskningsstudier som viser hvilken behandling som er best for denne pasientgruppen. Vi har utviklet et rehabiliteringsprogram for dere med diagnosen impingement (FAI) som er nøye beskrevet og baserer seg på vitenskapelig kunnskap i forhold til det vi i dag vet om pasientenes symptomer og funksjonsproblemer. Alle pasientene i denne studien på effekt av kirurgi får tilbud om dette rehabiliteringsprogrammet som skal gjennomføres hos fysioterapeuter som er spesialister på feltet. Hele forskningsprosjektet gjennomføres gjennom Ortopedisk avdeling ved Oslo Universitetssykehus, Ullevål.

Hva innebærer studien?
Pasienter som henvises til en ortoped kirurg for hoftesmerte der man undersøker om pasient har inneklemmingssyndrom (FAI) eller labrum skade (ledd-leppe skade), vil bli invitert til å delta i studien. Dersom pasienten samtykker til å delta i studien, vil de gjennomgå en førstegangsvurdering der de fyller ut spørreskjemaer om hoften, samt utfører noen fysiske tester. Disse testene vil inkludere bevegelighet i hoften, hofte muskelstyrke og balansetest. Det vil også bli tatt rutinemessige bilder av hoften ved røntgen og magnetisk resonans (MR) undersøkelser, i tråd med gjeldene praksis ved

denne tilstand. Pasienten vil så tilfeldig, ved loddtrekking, velges ut til enten kirurgisk behandling gjennom kikkehullsmetoden eller bare kikkehullsmetoden som diagnostisk verktøy for vurdering av hofteleddet. Pasientene vil ikke bli informert om hvilken gruppe de inkluderes i før det er gått ett år. Dette er helt sentralt for at man skal kunne vurdere effekten av behandlingen (blinding av pasienter i forhold til behandlingsgruppe).

De som utvelges til gruppen med kirurgisk behandling vil gjennomgå avmeisling av benpåleiringer og/eller behandling av bindevevsringen i hoften (labrum) som er det vanlig behandlingsopplegget ved denne tilstanden. De som utvelges til den diagnostiske kikkehullsgruppen (artroskopi) vil ikke gjennomgå noe ytterligere kirurgisk inngrep i hofteleddet hvis ikke det er helt spesielle indikasjoner for det (eks. på det kan være: store løse biter i leddet eller totalt avrevet ledd-leppe). Dersom ortopeden gjør slike funn under operasjonen, vil ortopeden gjennomføre de inngrep som vurderes som nødvendige og du vil ikke være del av studien på effekt av kirurgi. Dersom slike funn blir gjort under operasjonen og du ikke lenger er en del av denne studien, vil du bli forespurt *etter operasjonen* om du kunne tenke deg og følges opp med de samme tester og oppfølgingstidspunkt som de som deltar i studien (oppfølgingsstudie).

Alle pasienter i studien på effekt av kirurgi vil gjennomgå et 3 måneder rehabiliteringsprogram etter kirurgi. Alle pasienter kommer til oppfølgingskontroll etter 3 måneder (ortoped og fysioterapeut), 6 måneder og 1, 2, 5 og 10 år etter operasjonen. Alle fyller ut de samme spørreskjemaene og utfører de samme testene, alle vil få informasjon om hvilken gruppe de har tilhørt 1 år etter kirurgi.

Dersom pasientene er bekymret for hoften sin etter operasjonen, har de mulighet til å snakke med kirurgen for å diskutere sine problemer og få videre behandling om dette kreves (dette kan bety at de ikke lenger er med i studien). De pasienter som ikke ønsker å delta i studien som vurderer effekten av kirurgi, vil bli tilbudt å delta i en oppfølgingsstudie etter operasjonen som beskrevet over. Det innebærer å gå gjennom de samme vurderingene og målinger og tester ved de samme tidsintervallene som angitt i dette samtykket (3 og 6 måneder og 1,2,5 og 10 år).

Dersom pasienten ikke ønsker å delta i studien som vurderer effekten av kirurgi, eller i oppfølgingsstudien, vil deres medisinske behandling ikke påvirkes av at de ikke ønsker deltakelse i noen av disse prosjektene.

Ved 2, 5, og 10 års oppfølgingen vil vi søke Leddproteseregisteret i Norge om å koble data for å se om du har fått satt inn protese i hofteleddet. Vi vil også koble data fra denne studien etter 20 år til Leddproteseregisteret. Begrunnelsen for dette er at man lurer på om det er en økt risiko for artrose (slitasjegikt) ved denne type hofteproblemer, og om et kirurgisk inngrep påvirker utviklingen av artrose (slitasjegikt). Dersom du samtykker i å delta i denne studien så vil vi etter 2, 5, 10 og 20 år koble data fra Leddproteseregisteret med dine data fra studien.

Mulige fordeler og ulemper

Fordelene med å delta i denne studien som vurderer effekten av kirurgi er at man får et spesialtilpasset rehabiliteringsopplegg og en veldig systematisk oppfølging over tid, ikke bare rett etter kirurgi, men også langtidsoppfølging for å vurdere langtidsendringer

i hofteleddet. Videre vil det være store fordeler for fremtidige pasienter med samme diagnose som overveier å gjennomgå kirurgisk behandling av hoften. Denne studien vil utvikle kunnskapen på feltet og kunne vurdere effekten av kirurgisk behandling både på kort og lang sikt.

De mulige ulempene ved denne studien på effekt av kirurgisk behandling inkluderer:

(i) Tilfeldig fordeling til gruppene vil være ukjent for pasientene inntil 1 år etter kirurgi. Begge gruppene vil få informasjon om funn fra hofteleddet ved kikkehullsoperasjonen. Noen vil muligens oppleve det som en ulempe at de ikke vet om det også er gjennomført kirurgisk behandling av deler av hofteleddet.
(ii) Ionisk stråling gjennom røntgenundersøkelse. Røntgenundersøkelsene ved start (baseline) er nødvendig for å kunne beskrive strukturforandringer i hofteleddet. Eksponert mengde ioniserende stråling er meget liten og ingen skadelige effekter av stråling av denne dosen har blitt vist. Dette er videre undersøkelser som rutinemessig gjennomføres for alle som skal gjennomgå artroskopi. MR undersøkelsene, er ikke ioniserende stråler, men tar noe ekstra tid. Men dette er også del av eksisterende rutiner for pasienter som skal gjennomgå hofteartroskopi i dag. Dette er bilder som rutinemessig tas i klinisk vurdering av hoften der man vurderer hofteartroskopi som behandlingsmetode
(iii) Pasientens forpliktelser i forhold til tid. Studien inkluderer oppfølgingsvurderinger, hver av ca 90 minutters varighet ved start og etter 6 måneder og 1 år oppfølging, samt etter 5 og 10 år. I tillegg kreves det at pasientene deltar på 12 aktiv rehabiliteringssesjoner, hver av 60 minutters varighet, og fullfører hjemmeøvelser etter program. Behandlingene med aktiv rehabilitering inkluderer også andre fysioterapi tiltak der det er indisert, og vil bli gjennomført av kvalifiserte og spesielt erfarne fysioterapeuter. Til tross for at det er usannsynlig, har alle typer behandlinger potensiale for å forverre symptomer. Bivirkninger av fysioterapi som følge av behandling er svært usannsynlig, men dog mulig. Kirurgi vil alltid være forbundet med en viss risiko. Jo mer omfattende kirurgi, jo større risiko for komplikasjoner De vanligste komplikasjoner er skader på nerver og blodkar i operasjonsområdet, samt leddbrusk-skader etter instrumentene som føres inn i leddet.
Noen hendelser er relatert til enhver form for kirurgisk metode, og inkluderer risiko i forbindelse med anestesi, og risiko for post-operativ infeksjon. Denne risikoen er lik for begge gruppene.

Alle pasienter har selvsagt lov til å trekke seg fra studien på et hvert tidspunkt uten at det skal ha noen konsekvenser for videre behandling.

Hva skjer med testresultatene og informasjonen om deg?
Testresultatene og informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene og prøvene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger og testresultatene gjennom en navneliste som er innelåst etter gjeldende retningslinjer. Det betyr at opplysningene er avidentifiserte. Listen som kan knytte navnet ditt til koden vil kun bli lagret på sykehuset, og det er utelukkende autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg.

Denne studien vil, i tråd med kravene andre forskningsprosjekter, bli registrert i the United States Clinical Trials Registry, the Australian and New Zealand Clinical Trials Registry; ISRCTN registry; og the European Union clinical trials registry.

Ingen pasientdata som kan knyttes til deg som person er lagt inn i disse registrene som her er nevnt. Denne type forskningsregistre skal kun ivareta kvaliteten av studien og etiske hensyn ved gjennomføringen av studien. Data fra studien vil bli slettet 15 år etter at den siste rapporten er publisert. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse er publisert.

Frivillig deltakelse
Det er frivillig å delta i studien. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke til å delta i studien. Dette vil ikke få konsekvenser for din videre behandling. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side.

Om du nå sier ja til å delta, kan du senere trekke tilbake ditt samtykke uten at det påvirker din øvrige behandling.

Dersom du har spørsmål til studien, kan du kontakte Professor May Arna Risberg på telefon 41 31 27 76 eller Professor Lars Nordsletten på telefon 917 21 568.

Pasientens ansvar
Pasienter som velger å bli med i denne studien har ansvar for å delta på alle test-konsultasjoner, besøk hos kirurgen og rehabiliteringssesjoner, eller om dette ikke er mulig, finne en alternativ måte å gjennomføre rehabiliteringen. Pasientene må også fylle ut alle elektroniske spørreskjemaer så godt de kan, eller informere studiekoordinatoren om at de ikke var i stand til å fullføre det. De må også kontakte studiekoordinatoren om de opplever forverring eller andre uønskede hendelser.

Vårt ansvar for pasientene i studien
Vi bekrefter at pasienten vil bli informert så raskt som mulig dersom ny informasjon blir tilgjengelig som kan påvirke pasientens villighet til å delta i studien.

Pasienter vil bli informert om mulige beslutninger/situasjoner som gjør at deres deltagelse i studien kan bli avsluttet tidligere enn planlagt.

Anslagsvis indikasjon på hvor mange deltakere som vil delta i studien Det er forventet at 140 pasienter vil delta i denne studien.

Kompensasjon, inkludert forsikring for pasienten om en pasientskade skulle oppstå som et resultat av studien.
Alle pasienter vil bli forsikret mot skader som oppstår som et resultat av studien, som en del av Oslo Universitetssykehus sin forsikring for forskningsprosjekter.

Eventuell kompensasjon til og dekning av utgifter for deltakere
Pasienter er kvalifisert for å få kompensasjon til dekking av reisekostnader til oppfølgingstidspunktene i forbindelse med dette prosjektet.

Personvern

Opplysninger som registreres om deg er kun tilgjengelig for forskningsteamet, og er lagret separat fra dataene for å sikre at de er avidentifiserte. Dette inkluderer lagring av det informerte samtykket, deltakerens navn, kontaktinformasjon og fødselsdato, som vil bli lagret i låste kartotekskap og på en passordbeskyttet harddisk. All annen data er identifisert med deltaker-kode, og vil bare være tilgjengelig for forskningsteamet. Alle kirurger, testpersonell og behandlende fysioterapeuter er registrert som helsepersonell og er således bundet av taushetsplikten. I opplæringen av testpersonell og behandlende fysioterapeuter vil disse også bli påminnet om sine forpliktelser om fortrolighet i forhold til pasientene

Utlevering av materiale og opplysninger til andre
Hvis du sier ja til å delta i studien, som er en internasjonal studie, gir du også ditt samtykke til at avidentifiserbare testresultater utleveres til de forskerne som er med i denne studien fra Australia, Storbritannia, Canada, Danmark og Sverige. Forskerne i andre land vil ikke kjenne din identitet og vil være underlagt de samme sikkerhets- og personvernsregelene som de norske forskerne.

Rett til innsyn og sletting av opplysninger om deg
Hvis du sier ja til å delta i studien, har du rett til å få innsyn i hvilke opplysninger som er registrert om deg. Du har videre rett til å få korrigert eventuelle feil i de opplysningene vi har registrert. Dersom du trekker deg fra studien, vil ikke flere opplysninger samles fra deg. Opplysninger som allerede er samlet vil ikke bli slettet.

Økonomi
Studien er finansiert gjennom forskningsmidler fra Helse Sør-Øst.

Forsikring
Du har de samme rettighetene og forsikringsvilkårene som du ville hatt dersom du ikke deltok i denne undersøkelsen.

Informasjon om utfallet av studien
Pasientene i studien vil bli informert om resultatene gjennom en skriftlig rapport.

Samtykke til deltakelse i studien

Jeg er villig til å delta i studien

------- (Signert av prosjektdeltaker, dato)

Jeg bekrefter å ha gitt informasjon om studien

------ (Signert, rolle i studien, dato)