

**Movement Aberrations in Patients with**  
**Long Lasting Subacromial Impingement Syndrome**

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## **ABBREVIATIONS**

ACL	Anterior Cruciate Ligament
CBE	Comprehensive Body Examination
CBT	Cognitive-Behaviour Therapy
GH	Glenohumeral
GPE-52	Global Physiotherapy Examination
GPM	Global Physiotherapy Muscle Examination
ICC	Interclass Correlation Coefficient
IC	Confidence Intervals
M	Muscle
p	Probability (significance)
r	Correlation Coefficient
REK	Norwegian Ethical Commission
ROM	Range of Motion
SIS	Subacromial Impingement Syndrome
SPADI	Shoulder Pain and Disability Index
SPSS	Statistics Program for Social Sciences
TSK	Tampa Scale of Kinesiophobia
TSS	Temporal sensory summation
T	Thoracic spine
US	Ultrasound

## Abstract English

**Background:** Little research has been done to investigate possible movement aberrations in patients with long-lasting (> 12 weeks) shoulder impingement syndrome (SIS). Focus so far has mainly been on possible somatic complaints of the shoulder joint and its surrounding tissues. This study examines if patients diagnosed with long-lasting SIS have only localized complaints or aberrations in movements and fear avoidance beliefs as possible perpetuating factors.

**Aim and objective:** The objective was to explore possible movement aberrations in patients with SIS by using the movement items from Global Physiotherapy Examination (GPE-52), Tampa Scale of Kinesiophobia, Pain Drawing, and Shoulder Pain and Disability Index (SPADI). The aim of this study was to assess whether or not the pain in patients with complaints for longer than 12 weeks is related to a localized tissue specific reason or a general and possible central driven sensitization process.

**Method:** The study has a non-experimental, descriptive cross-sectional design. The study was carried out in an outpatient clinic specialized in shoulder complaints. Patients (n=22) diagnosed with SIS filled in questionnaires and were subjected to the physical examination. The GPE movement scores were categorized into normal, moderately or highly aberrant.

**Results:** Patients with long-lasting SIS was found to be highly aberrant in their movements in 64 % of the cases and moderately in 32 %. There was a tendency to high fear avoidance beliefs in 59 % of the subjects, and 36 % had widespread pain. No association between movement aberrations and fear avoidance or self-reported pain and dysfunction was found.

**Conclusion:** In this sample of patients with long lasting SIS a majority had aberrance in movement and fear avoidance beliefs. Although the majority reported to have only localized pain, the high number having aberrations regarding general movements and fear of movement may indicate that there are other processes present than only local disturbances in patients with long-lasting SIS.

**Bakgrunn:** Lite forskning har blitt gjort for å se på hvilke mulige bevegelsesproblemer det er hos pasienter som er diagnostisert med langvarige (> 12 uker) Subakrominalt Innklemmings Syndrom (SIS). Det største fokuset har hittil vært på vevsspesifikke patologier av strukturene rundt skulder som årsak til denne smerten. Denne studien vil undersøke om pasienter som er diagnostisert med langvarig SIS har en vevsspesifikk patologi eller et generelt bevegelsesproblem og frykt for bevegelse som mulig opprettholdende faktorer for sine plager.

**Hensikt:** Å undersøke tilbakeholdenhet i bevegelse hos pasienter diagnostisert med SIS ved hjelp av bevegelsestestene i den modifiserte Globale Fysioterapi Metoden (GPE-52), skulder et spørreskjema om bevegelsesangst (TAMPA), smertetegning, og et spørreskjema om skuldert smerte og funksjon (SPADI). Målsetningen er å se om pasienter med langvarige skuldert smerter (> 12 uker) har en lokalisert vevsspesifikk årsak eller en generell og mulig sentralt sensitiviserende prosess.

**Metode:** Dette er en ikke- eksperimentell tverrsnitts studie som ble utført ved en skulderpoliklinikk. Etter pasientene (n=22) var diagnostisert med SIS av lege, svarte de på spørreskjemaer og det ble gjort fysiske bevegelsestester. GPE-52 bevegelsestestene ble kategorisert som normal, moderat og sterk tilbakeholden.

**Resultat:** Pasienter med langvarig SIS hadde sterk tilbakeholdenhet i bevegelser i 64 % av tilfellene og moderat i 32 %. Det viste en tendens til høy bevegelsesangst i 59 % av pasientene og 36 % hadde generaliserte smerter. Det var ingen korrelasjon mellom tilbakeholdenhet i bevegelser og bevegelsesangst eller selvvardert smerte og funksjon.

**Konklusjon:** I denne populasjonen med langvarig SIS hadde største delen tilbakeholdenhet i bevegelser og bevegelsesangst. Selv om størstedelen anga å ha lokaliserte smerter, så kan det høye antallet med generalisert tilbakeholdenhet i bevegelse og bevegelsesangst indikere at det er andre prosesser tilstede enn bare de lokale forstyrrelsene i pasienter med langvarig SIS

## 1. INTRODUCTION

### *1.1 Background*

Working at a shoulder clinic for some years, it has become apparent that impairments and pain in the shoulder area can be debilitating (Hoy et al., 2014). In order to give proper treatment, an individual approach to the treatment strategy seems to be necessary. This requires a correct diagnosis and that possible perpetuating factors have been addressed and managed.

Subacromial impingement syndrome (SIS) is one of the most common shoulder pathologies (Braun and Amundson, 1989; Koester et al., 2005; Strunce et al., 2009). Despite being a common shoulder complaint, SIS has an overall vague description and little is known to what extent possible underlying pathologies can cause the syndrome (Lund, 1993; Heredia-Rizo et al., 2013). However, there are many suggestions to why such a syndrome arise and the literature describes SIS often as a somatic pathology, focusing especially on the qualities of tissues in the shoulder region (Andrews, 2005; Gebremariam et al., 2014). A disruption in the biomechanical mechanism is vividly discussed as a reason to the various pathologies, i.e. rotator cuff tears or tendinitis, bursitis, etc. (Poppen and Walker, 1976; Ludewig and Cook, 2000; Cools et al., 2003). Some studies have investigated possible aberrations, central sensitization mechanisms and fear avoidance beliefs in this patient group (George et al., 2008; George and Hirsh, 2009; Gwilym et al., 2011; Kromer et al., 2014). The importance of good psychosocial relations, work satisfaction, cognitive and behavioural patterns, are high ranking in order to avoid perpetuating factors for shoulder dysfunctions (van der Heijden, 1999; Widanarko et al., 2014). Both biological, psychosocial and social factors, are advocated as potential causes of SIS, as in other musculoskeletal disorders (Linton, 1995).

In order to assist the healing process it is important to know what therapy strategy to choose and therefore have knowledge about possible underlying factors for pain and dysfunction. Do patients have a reduction of the ability to move and/or do they have fear of the pain when moving? To what extent should you treat only local pathologies if and when the pain is more widespread? Currently, SIS is treated with a number of different approaches, ranging from surgery to physiotherapy and manual therapy, all with a vast variety of techniques (Lund, 1993; Michener et al., 2004; Geraets et al., 2006; Kromer et al., 2009) It can be time consuming treating SIS and only 50 % of new episodes of reported shoulder pain in primary care have a complete recovery within 6 months (Kuijpers et al., 2004).

Being a manual therapist, the author's interest lies primarily within the possibilities of manual therapy in treatment of patients with SIS. As SIS is a complex diagnosis to treat, it is challenging



to provide the most efficient treatment possible for these patients. More research is required to investigate the role of possible perpetuating factors, such as general movement aberrations, fear avoidance, and general pain in this patient group.

### *1.2 Shoulder Anatomy*

The shoulder girdle is a complex movement system dependent on cooperation between joints, ligaments, capsule, bursa and muscles. The joint complex consist of four joints; the glenohumeral joint (GH), the acromionclavicular joint (AC), the sternoclavicular joint (SC), and the movement of scapula over thorax (Kapandji, 1980). The GH has most movement of all the joints in the body (Kapandji, 1980) with six movement directions; three rotations and three translations (Browne and al., 1990; Michener et al., 2003). This flexibility is possible due to the anatomical structure and the relative laxity of the shoulder capsule. Such an amount of mobility requires stability and control, in which the muscles and ligaments play a central role.

According to their function or location, the shoulder muscles can be divided into groups. The rotator cuff, which consists of the muscles (m) m.teres minor, m.infraspinatus, m.supraspinatus, and the m.subscapularis, are the pivots of the shoulder (Kahle et al., 1998). These muscles are considered to be the stabilizers of the shoulder and are attached to the humeral bone. They rotate and partially abduct the arm and are responsible for the precise fine-tuning of a movement. Together with the biceps tendon these muscles fill up the subacromial space. The m.deltoidus, m.latissimus, m.teres major are also attached to the humeral bone, but create the larger movements of the arm (Kahle et al., 1998). The long head of biceps m. attaches onto the tuberculum supraglenoidale and is responsible for abduction, internal rotation, and flexion over the shoulder (Bullock et al., 2005). There are also other muscles participating in the shoulder girdle movement, such as m.serratus anterior and posterior and m.rhomboideus. Due to their positioning and attachment on the shoulder girdle, these muscles have a more indirect function, but are important in the stabilization of the shoulder by the movements they make at the scapula (Kapandji, 1980). This intricate muscle system needs to be synchronized in order to prevent narrowing of the subacromial space with shoulder movement (Andrews, 2005).

A bursa is a cushion mainly situated in three places around the shoulder and filled with fluid. Its main function is to lubricate and avoid direct contact between the bony structures and muscles caused by friction in the shoulder joint (Hanchard et al., 2013).

The ligaments and capsule around a joint are passive structures as they do not have contractile muscle fibers. However, they will influence the direction of a movement depending on their attachment to the bony structures and to the hardness of the ligamentous fibers (Kahle et al., 1998). These structures can change or restrict the joint's arthro-kinematical pathways when the ligaments are taut, but also create a functional instability if they are too loose (Cools et al., 2008). The robustness of the shoulder system appears to be a compromise between the flexibility and strength required, independent of the variations within the anatomical structures (Veegera and Helma vd, 2007).

### *1.3 Subacromial Impingement Syndrome Definition*

So far, there is no consensus to what the definition of SIS is (Michener et al., 2009).

Historically Dr. Neer presented the impingement syndrome as a diagnosis to when the rotator cuff tendons are compressed by the anterior acromion at a position of internal rotation in 90° abduction of the GH joint. Dr. Neer considered this to be the reason for shoulder pain when injection with analgesics were administered at the compressed tendons and the pain disappeared (Neer, 1972). The majority of the literature describes SIS vaguely by suggesting that all anatomical structures between the humeral head, acromion, coracoacromial ligament, and the AC joint can be affected (Ottenheijm et al., 2010). Lesions have been reported to range (or include) from inflammation of the subacromial bursa or lesion to the rotator cuff in the form of partial or full thickness muscle or tendon tears or inflammation calcifications within the tendons (Michener et al., 2003; Michener et al., 2004; Lewis et al., 2005; Kromer et al., 2009; Theisen et al., 2010; Ottenheijm et al., 2011). Ottenheijm et al. (2010) stated more specifically in their review that the prevalence of subacromial complaints are 30-39 % due to tendinopathy, 13-15 % to calcification of the tendons, 13-51 % to partial thickness tears, 24-70 % full thickness tears, and 12-56 % to bursitis. Unfortunately, the pathogenesis is not so clear (Lund, 1993; Andrews, 2005).

There are many factors considered to play a part in the pathogenesis of SIS. The arthrokinematics of the shoulder girdle is considered to play a role in addition to the structural dysfunctions and lesions that cause pain (Michener et al., 2003). The theory of the disrupted arthro-kinematics is strengthened by the fact that the pathology has a slow onset of the shoulder complaint, and is not caused by trauma (Koester et al., 2005).

Internal impingement has developed as a new explanation for compression of structures in the subacromial space. Internal impingement is considered to be due to tears in the posterior-superior labral structure and partial tears of the tendocapsular structure. Together this cause compression between the posterior superior glenoid and the tendinous insertion of the supraspinatus and the infraspinatus at maximal external rotation in 90° abduction (Walch et al., 1992). These compressions are frequently seen in sports where overhead movements are made (Cools et al., 2008).

#### *1.4 Prevalence and Risk Factors of Subacromial Impingement Syndrome*

SIS accounts for 44 – 65 % of all shoulder related pain and reduced shoulder functions (Lund, 1993; Michener et al., 2003; Lewis et al., 2005; Kromer et al., 2009; Ottenheijm et al., 2011; Braman et al., 2013; Nagarajan and Vijayakumar, 2013). In Norway, 36 % of work related absence in 2013 was due to musculoskeletal pain, of which shoulder pain was one of the largest subgroups (21%) (NAV, 2014). According to Brox et al. (2010), SIS accounts for one third of appointments to general practitioners. In a review study based on 17 articles on shoulder pain of the GH structures in the general population, they found the time aspect prevalence to be of 7 – 26% on point prevalence, 19 – 31 % prevalence for a month, 5 – 47 % for a year and the prevalence for a lifetime 7 – 67 % (Luime and al., 2004). This shows that shoulder complaints can be a prolonged process and that not everyone recovers.

The prevalence of SIS in work-related activities show that physical work depends on awkward positions, gripping or sustained hand movements, prolonged sitting positions, or the use of vibrating tools (Widanarko et al., 2014). Bodin et al (2012) found that the strongest predictor for rotator cuff injuries was age and work requiring abduction of the shoulder. In a review by van Rijn et al. (2010), force used in shoulder or hand, repetitive lifting more than 20 kg a day, repetitive movements of the shoulder, wrist or hand, working with the hand above shoulder height or with the shoulder in flexion, were found to predict SIS. These conclusions by van Rijn et al. (2010) were based on single studies and not confirmed by similar studies.

#### *1.5 Shoulder Pain and Sensitization*

International Association of the Study of Pain defines pain as “An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms

of such damage” (Pain, 1994). The biological function of pain is clear, it promotes the survival by getting the body ready to escape from danger (Boyling and Jull, 2004).

When having a lesion or a threat thereof, the pain is felt as nociceptive sensations to tissues and structures of the shoulder area and can extend downwards into the arm or towards the neck (Bergman et al., 2004). Pain is often felt when sleeping on the shoulder or when using it (Beaton and Richards, 1996). It has an alarming function telling us that something is threatening the integrity of the anatomy and this will cause harm if position or movement is not changed. Noxious stimuli is a physiological effect whereby neurons throughout the nervous system spill out a variety (or cascade) of chemical irritants. In SIS, this could be because of mechanical overpressure on the shoulder structures (Sluka, 2009). Nociceptive nerve endings register this in the affected tissue and sends signals to the nearest registration port, which is the dorsal root ganglion. This bundle of nerve cells lies just outside of the vertebral canal and is the first place where the signal is evaluated. If considered strong enough, it will be sent onwards to the brain which will react to the potential harm caused to the body (Butler and Moseley, 2003). This process is called acute pain and is related to tissue damage or threatening damage (Sluka, 2009).

The different tissues, i.e. ligaments, muscles etc. have well defined healing processes and time aspects of recovery (Butler and Moseley, 2003). Every injury will heal with time, but sometimes the pain remains and outlasts the expected curative period. This process is called long-lasting or chronic pain and happens when the brain has concluded that the threat is still present and the body still needs protection (Sluka, 2009). At this point, the nervous system is sensitized, which means that the pain signal sent to the brain is normal but the mechanism of the transduction to the brain is altered. These signals then feed the brain with information that the danger is still present even though the affected tissues has healed (Butler and Moseley, 2003). Consequently, these mechanisms can have widespread effects on the body. More precisely, there is an alteration in the endocrine responses, an increase of the sympathetic nervous system activity, an increase in the immune system activity, and an activation of the phasic and long muscles. The muscles affected increase in tension, making them shorten and feeling stiff and achy. If the sensitization process proceeds, it will spread from one area to another and the pain will go from being local to more widespread. Eventually, the pain causes pain and a vicious circle has started (Butler and Moseley, 2003).

The sensory experience of unpleasantness that often follows with pain is associated with the physical and social contextual aspects of the situation. As with most human experiences, there

is vast variety of thoughts and meaning linked to the sensation of pain and the context in which pain occurs. This is referred to as a sensory-emotional dimension (Price, 1999).

Thoughts and believes around this hyper vigilant state can be influenced by it and initiate the fear-avoidance behaviour (Vlaeyen and Linton, 2012). The subconscious fear for re-injury and pain can result in physical disuse and passive coping strategies (see figure 1.) (Vlaeyen and Linton, 2012).

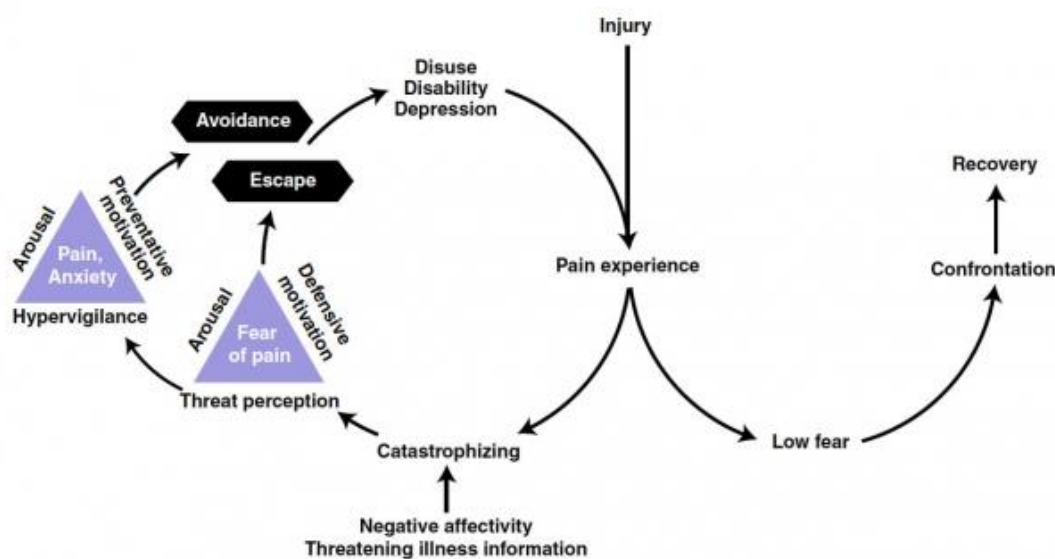


Figure 1. Schematic presentation of the fear avoidance model (Leeuw et al 2007) based upon the model of Vlaeyen and Linton (2002) and the fear anxiety model of Asmundsen et al. (2004).

### 1.5 Clinical Assessment

It is important to consider all predictive factors when diagnosing SIS, such as psychosocial, clinical and work/ sports related factors (Kuijpers et al., 2004). In addition, a manual therapist examines the affected area, as well as the surrounding joints and corresponding segments of the vertebra. Therefore, the cervical and the thoracic vertebra are considered important in their influence on the shoulder movement and pain presentation (Theisen et al., 2010; Osborn and Jull, 2013).

In order to determine which of the anatomical structures of the shoulder that may cause SIS, one relies on general practice of the physical tests and the clinical reasoning process. However, the physical tests come in many variations and have a great diversity in how they are performed

and interpreted (Hanchard et al., 2013). For the shoulder, five tests are considered the most important in the diagnostic process of SIS (Michener et al., 2009). The Neer and the Hawkins-Kennedy tests compresses the subacromial space by creating over-pressure in the GH joint by the examiner and are considered positive when pain occurs superior to the shoulder. The painful arc test is an active test where the patient lifts the arm up sideward and complains of pain in an area of 60-160 degrees due to compression in the subacromial area. The empty can and external rotation resistance tests are considered positive for tears in the muscles if weakness is found that differs from the unaffected side (Michener et al., 2009). According to Michener et al. (2009) these tests can rule out SIS if three or less out of the five are positive. In contrast, SIS is ruled in when three or more tests are positive. Hanchard's et al. (2013) concluded in their review that there is insufficient evidence that any physical test can confirm pathology in SIS.

More advanced diagnostic tools as ultrasound (US) and magnetic resonance imaging (MRI) are often used to determine which tissues are affected. US is found to be especially useful to diagnose muscle and tendon pathologies and is supposed to be equally good as MRI. MRI is more useful pre-operatively or in the presence of atypical findings (Brox and al, 2010). These investigations are good and reliable, but the extensive prescription of imaging can result in diagnosing tissue pathology which might not be the actual cause of the pain (Frost et al., 1999; Brox and al, 2010).

Therefore, mapping the active movement patterns to investigate which affected structures may impair the kinetic chain in a movement is of great importance to the manual therapist. In a painful shoulder, movement aberrations are considered present (Sahrmann, 2002). This anticipates correlation between impaired movements and symptoms. Evidentially, even the most experienced therapist cannot determine a 'sick' shoulder without knowing the patients history (Hickey et al., 2007). This underlines the need for validated and sensitive tests to determine if aberrations are pathological or just a deviation from normal movement pattern, especially in patients with long-lasting pain.

A clinical way to test for movement aberration is by using the Global Physiotherapy Examination Movement (GPE-Movement). This is a shortened version of the Global Physiotherapy Muscle Examination 78 (GPM-78) (Sundsvold et al., 1982) and the Global Physiotherapy Examination (GPE-52), revised by Kvåle et al. (2003). The GPM-78 and GPE-52 were designed to aid psychomotor physiotherapists to quantify physical impairments in patients with long-lasting musculoskeletal disorders. Kvåle et al. (2003) have demonstrated that

it can be sufficient to use only the Movement domain in a reliable and valid manner (Kvåle et al., 2003a; Kvåle et al., 2005). Psychomotor physiotherapists works with the assumption that bodily reactions are associated with the state of mind. When stress, both physical and psychological, are involved over a period of time, this will affect the ability to relax and the muscle tension (Sundsvold and Vaglum, 1985). Being able to quantify this, GPE-Movement (attachment 2) can be used to detect the effect of long term stress on the body, give an insight to how widespread it has become, help in deciding on treatment and to see if the treatment works (Kvåle et al., 2003b).

Patients with long-lasting pain can develop a fear for re-injury and pain. This is demonstrated to relate more to depression and catastrophizing than pain and coping. The Tampa Scale of Kinesiophobia (TSK) is a self-report instrument to assess this fear of movement and/or re-injury in chronic pain patients (Woby et al., 2005; Haugen et al., 2008) (attachment 3). Originally, it had 17 items with a 4-point scale (1 = I strongly disagree, 4 = I strongly agree), and was used mainly in patients with low back pain. Four of the questions were later reversed and TSK has now been used to discriminate between chronic musculoskeletal patients with phobia or moderate fear for pain (Lundberg et al., 2009; Hudes, 2011). The higher the score, the more indication of fear and anxiety for movement (Vlaeyen et al., 1995). Lundberg et al. (2009) argue for the use of TSK in every patient group. Feleus et al. (2007) demonstrated that it is valid in patients with arm, neck, and shoulder pain. A shorter version of the Tampa-scale with 13 questions was then used (Feleus et al., 2007).

The pain drawing is a frequently heuristic used tool to detect the extent, location and type of pain (attachment 4). The pain drawing constitute of a body diagram with many squares representing the back and front of the body. The test can be used to clinically distinguish between neuropathic pain and referred pain (Ohlund et al., 1996). It can also indicate whether the pain is generalized or local, and has high reliability (Margolis et al., 1986; Skouen et al., 1997; Kvåle et al., 2003a). It has been suggested that a high level of stress may increase the number of boxes marked, but there is contradicting evidence to support this notion (Margoles, 1983; Margolis et al., 1986).

Patient rated outcome measures are important and often used in the clinical decision making process in rehabilitation. The Shoulder Pain and Disability Index (SPADI) (attachment 5) is a well-established questionnaire designed to give an insight to the shoulder patient's current self-

experienced pain and disability (Breckenridge and McAuley, 2011). SPADI has 13 items divided over the two domains pain and disability, as shown in attachment 1. The original version asks the patient to grade the symptoms, using a visual analogue scale (VAS) from 0 to 100, where 0 is no pain or disability and 100 is the ‘worst pain imaginable’ or ‘too difficult’ (Roy et al., 2009; Hill et al., 2011). A newer version has been made with the intent to be easier to administrate and score by using the numeric rating scale (NRS) (Williams et al., 1995).

### *1.7 Shoulder Treatments*

Physiotherapists encounter SIS frequently in the clinic and it is a cause of great economical costs (Strunce et al., 2009). Treating SIS can be time consuming and only 50 % of new episodes of reported shoulder pain in primary care have a complete recovery within 6 months (Kuijpers et al., 2004). The treatment approach is defined by what tissues pain and dysfunction seems related to and what other reasons seemingly can be the cause for the impingement. If any joint articulation is impaired, a manual therapist will address this and can use mobilisation or manipulative techniques to create a release in the joint and in such a manner help to decompress the subacromial space. This goes for the joints in the shoulder girdle, but also for restrictions found in the cervical and thoracic spine or facet joints (Green et al., 2003; Fernández-Carnero et al., 2008; Ho et al., 2009).

However, the presence of perpetuating factors such as psychosocial problems, fear avoidance strategies, stress, also needs to be addressed. All contributing factors of long lasting pain in patients can be better dealt with in a multidisciplinary setting when it is known what the content of the programs are (Guzman et al., 2002). How the therapy will be given depends on the degree of aberration and if it is local or widespread. According to the extent of the problem, the more disciplines are involved. The physio-/manual therapist can address the fear avoidance, explain the pain, and reassure them through graded exposure that it there is no harm in moving the arm, as well as treating the local disturbances (Butler and Moseley, 2003). The group of patients with a higher degree of depression or anxiety can be helped with the Cognitive Behaviour Therapy (CBT) approach (Spence, 1989). CBT addresses coping strategies, behaviours, emotions, physical aspects, and environmental conditions, by using graded activity, problem solving thoughts, biofeedback, and cognition to alter the negative spiral (Van Dessel et al., 2014). Psychomotor physiotherapy is known to have a beneficial effect in patients with



widespread pain and behaviour graded exercise therapy are more effective than usual care in the short term and long term (Geraets et al., 2006; Breitve et al., 2010).

## 2. AIM

### *2.1 Objective*

The objective of this master thesis was to explore the degree of general movement aberrations and fear of movement in patients with SIS, in order to discuss whether aberrations in these domains can reflect a presence of more widespread problems. The overall aim was therefore to assess whether or not patients diagnosed with SIS complaints for longer than 12 weeks have general movement dysfunction, fear avoidance beliefs, and localized or widespread pain.

### *2.2 Research Questions*

- Is general movement aberrations present in patients diagnosed with SIS?
- Do patients with long-lasting SIS have fear avoidance beliefs?
- Do patients with long-lasting SIS have widespread pain?
- Is there an association between general movement aberrations and fear- avoidance beliefs in patients with SIS?
- Is there an association between general movement aberrations and self-reported shoulder pain and dysfunction?

## 3. METHOD

### *3.1 Study Design*

The current study has a non-experimental, cross-sectional design to investigate the possible presence of general movement aberrations and fear of movement in patients diagnosed with SIS. This descriptive epidemiological design will provide a status report of patients with diagnosed SIS at a given point in time to be able to reflect upon the possibility of a more widespread problem (Domholt et al., 2005).

### *3.2 Recruitment and Procedure*

Patients with shoulder complaints were referred to a multi-disciplinary outpatient shoulder clinic for shoulder related problems by their general practitioner, manual therapist, physiotherapist, or chiropractor. At the clinic, the subjects were screened by a specialist using clinical tests such as Neer, Hawkins, Jobe, active and passive range of motion (ROM) of the

GH joint and cervical spine, Spurling test of the neck and US to diagnose the shoulder complaint.

After a medical specialist diagnosed them with SIS, the participants were invited to participate in the present study if they met the inclusion criteria. Having signed the informed consent, they were asked to fill out questionnaires prior to a physical examination with the GPE Movement tests performed by a physiotherapist. Three different physiotherapists, blinding the author to the test results, executed the testing procedure once. All patients, included or excluded in the trial, were given treatment after the testing (see figure 2).

The study was conducted for a six week period from 4<sup>th</sup> of August to 14<sup>th</sup> of September 2014. Of note, usage of medicine or cortisone injections could have taken place prior to testing, and might have caused a possible derived positive outcome on the dependent variables. Thus, medicine intake and cortisone injection was noted.

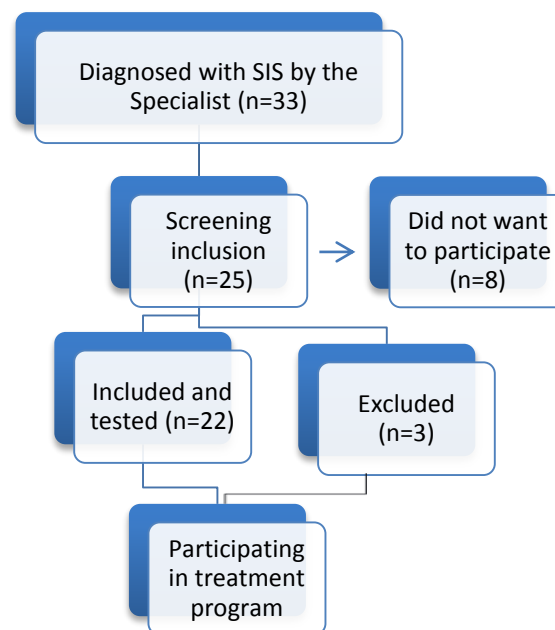


Figure 2. Flow chart of the enrolment process. All participants were first diagnosed by a specialist and ended in a treatment program, independent of participation in the study. 33 patients were diagnosed with SIS, eight chose not to participate, of the 25 remaining 22 were included and three were excluded.

### 3.2 Participants

Subjects diagnosed with SIS were asked to participate in the study and received information about the study at an information meeting prior to the first appointment with the physiotherapist. The physiotherapist screened for inclusion or exclusion criteria at the first appointment the same

week, and a written consent were obtained from the patients who met the inclusion criteria (attachment 7).

Inclusion criteria:

- Positive diagnosis by the specialist for SIS
- Pain when tested for one of the resistance tests of external or internal rotation, abduction or flexion
- Pain in the shoulder area around GH joint
- Symptoms for more than 12 weeks
- Pain > 2 on a numeric rating scale
- Age 18-65

Exclusion criteria:

- Known cancer in the past, received or undergoing treatment for cancer
- Any pathologies being a contraindication for manual therapy
- Previous surgery to the neck or trauma or fractures to the neck or shoulder
- Frozen shoulder or decreased ROM in all directions of the GH joint
- Known herniation of the cervical or thoracic discs
- Diagnosed with a psychiatric illness and taking antipsychotic medicine
- Not understanding the Norwegian language or being able to sign their consent
- Received shoulder treatment elsewhere within 6 weeks before the start of the trial
- > 9 on the Numerical Pain Scale

### *3.3 Variables*

The following measurements were used; aberration of movement was assessed with GPE-Movement, fear avoidance beliefs was measured with the Tampa Scale of Kinesiophobia, the extent of the pain was measured with a Pain Drawing and the SPADI was used for self-experienced shoulder pain and function (Table 2.).

#### *GPE- Movement*

Global Physiotherapy Examination Movement is a physical test to determine the patient's flexibility in the neck, trunk and extremities, and examines to what extent the patient offers resistance to handling by a therapist and resilience to pendular response. The person's ability

to relax is evaluated, as well as aberrations within general movements. The GPE-Movement is a shorter version of the GFM -52 and the domain Movement contains of the four sub-domains Passive range movement, Flexibility, Passive movement and Active movement, each having four tests. Each movement is scored according to a pre-defined scale with five main categories (-2, -1, 0, 1, 2), where 0 indicate ideal movement (Figure 3.). The main categories are further divided in three scores that has been rounded upwards to .3 and .7 (Kvåle, 2003b) to increase the reliability (Kvåle and Sundsvold, 1991). The GPE-Movement has been found to have a high degree of reliability, with high ICCs and low measurement error. The domain Movement has been shown to discriminate well between healthy persons and patients with long-lasting musculoskeletal pain, with a significant difference of  $P < 0.001$  and a ROC- area difference between the two of 0.894 (Kvåle et al., 2003b). Kvåle et al. (2003) also validated the GPE-52 Movement test to discriminate between patients with local and widespread pain. A high score indicate a higher degree of physical and psychological problems, mainly found in patients with widespread pain (Kvåle et al., 2001). The revised version of Movement that will be used in this study is considered valid and reliable in patients with long-lasting pain for more than 12 weeks (attachment 2) (Kvåle, 2003a). In this study, only the two sub-domains Flexibility and Passive Movement were used as they were considered adequate to determine if there were aberrations in general movements in patients with SIS.

The qualities in movement are defined as normal or ideal (0) when a person can move different body parts independently, passively or actively, and without restrictions (Kvåle et al., 2012). Scores away 0 indicate movement aberrations. When scoring, absolute scores from the four tests are summed, giving a max possible score of 9.2 for each sub-domain. Total sum score for two sub-domains is 18.4. A high score indicate a higher degree of physical and often also of psychological problems (Kvåle et al., 2001). Healthy persons have in the sub-domain Flexibility been found to have a mean sum score of 3.0 (SD 1.5) and a population of patients with long-lasting musculoskeletal pain had a mean value of 4.5 (SD 1.6) (Kvåle et al., 2003a). In the sub-domain Passive Movement healthy persons had a mean score of 1.8 (SD 1.2) and the patient group 3.2 (SD 1.7) (Kvåle et al., 2003b). Furthermore, the mean Movement score of healthy females was significantly less aberrant than the mean score of men ( $P < 0.01$ ) (Kvåle et al., 2003a).

To determine the degree of aberrance in this study, the scores were categorized into normal, moderate or highly aberrant, based upon the scores reported above for healthy persons versus

patient with long-lasting musculoskeletal pain. In the sub-domain Flexibility, normal was defined to range from 0.0 to 3.0 points, moderate from 3.1 to 5.3 points, and higher than 5.4 to be highly aberrant. In the Passive Movement sub-domain, normal was set to be ranging from 0.0 to 1.8, moderate from 1.9 to 3.1 and strongly aberrant higher than 3.2 points. The categorization for the total sum of the two sub-domains was defined as: normal was between 0.0 to 4.8 points, moderate aberrant from 4.9 to 8.5, and highly aberrant if higher than 8.6 points.

Domain	-		SCALE	+	
	-2 (too much )	-1 (somewhat)	0 (ideal)	+1 (somewhat)	+2 (too little)
	-2.3,-2.0, -2.7	-1.3,-1.0, -0.7	-0.3, 0.0, +0.3	+0.7 +1.0 +1.3	+1.7 +2.0 + 2.3
<b>MOVEMENT</b> 8 tests	Too flexible Increased movement		Good	Too restrained Decreased movement	

Figure 3. The schematics of how to score the domain Movement. The maximum score of 8 tests is 18.4 (2.3 x 8). The scores are rounded up to avoid many decimals. It has two main groups (negative or positive scores) and 0 is considered good or ideal. The tests are done on the left side or of the trunk/spine. When the test involve the shoulder, both sides will be tested and the mean will be used (Kvåle et al., 2003a).

#### *Tampa scale of Kinesiophobia (TSK)*

The TSK is a general instrument to assess fear of movement and / or re-injury in chronic pain patients (attachment 3) (Vlaeyen et al., 1995; Roelofs et al., 2004). Each item is scored on a four point scale (1 = I strongly disagree, 4 = I strongly agree). A high score indicates more fear and anxiety for movement. In the 17 item version, a cut off at 37 points indicate the limit for high degree of fear (Vlaeyen et al., 1995). There are shorter versions of the TSK available with good validation (Hapidou et al., 2012). Haugen et al. did a validation study of the Norwegian version of the TSK with good results for test - retest reliability and construct validity. The responsiveness among patients with sciatica showed low to moderate results, but it demonstrated satisfactory psychometric properties in the assessment of kinesiophobia (Haugen et al., 2008). The most common version has 13 questions with a minimum of 13 points and a maximum of 52, but there is no known cut-off value (Haugen et al., 2008). The 13-item version has been chosen in this study and a limit for positive, i.e. higher, fear avoidance for movement was chosen at 28 points and a higher.

### *Pain Drawing*

The pain drawing is a good way to get an impression of where in the body the patients feel their pain. The most common way to calculate the distribution and area of pain is by counting the number of marked squares on the diagram (Margolis et al., 1986). In this study, every square marked was counted as one, giving a maximum possible score of 116. Another way of using the body drawing is to categorize the patients into groups dependent on how and where they have marked their pain (Skouen et al., 1997; Kvåle, 2003a; Robinson et al., 2010), and thus categorize patients into whether they have localized or widespread pain. The pain is in this study considered widespread if boxes are marked both above and under a line drawn at the level of thoracic 12 or if more than 30 % of the squares are covered (attachment 4). If pain only is marked above the line, the pain is considered as more specific and localized.

### *Shoulder Pain and Dysfunction Index*

SPADI is a self-report questionnaire with 13 items of two dimensions, Pain and Disability, as shown in attachment 5. In this study, the patients graded their symptoms using a visual analogue scale from 0 to 10. The scores are added up per domain and the total score can vary from 0 to the maximum sum score of 130. SPADI summoned score is according to the sum of the five questions related to pain, and the eight questions related to function/disability. This score is calculated as described by Roach et al. (1991), where the mean score of each subscale is averaged and divided with 100 to get the percentage. Each dimension can be looked at separately, or the sum score can be used. SPADI is commonly accepted for registration of self-experienced disability and pain and the response is considered to be moderately valid (Ekeberg et al., 2008; Michener et al., 2009). Ekbergs et al. (2006) found no plateau or ceiling effect in terms of total SPADI score, but detected a floor effect for the individual scores. Thus, the total SPADI score is considered to be a reliable questionnaire, and acceptable to use both in cross-sectional studies and in a prospective study when assessing Norwegian speaking patients with rotator cuff injury (Farrar et al., 2001; Ekeberg et al., 2008). In this study, the total score is used to assess the patient's own experience of their shoulder pain and dysfunction. Of the total score, a score between 0 and 30 points is in this study defined as indicating little pain and dysfunction, between 31 and 60 is moderate, and 61 to 100 as a high degree of pain and dysfunction.

Table 1. Reliability, validity and measurement of the tests

Variable	Reliable	Validity	Measurement
GPE-52 Movement	Yes (a)	Good	Flexibility, and ability to relax, degree of aberrant general movements
Pain Drawing	Fair (b)	Good	Local or widespread pain
Tampa-scale of Kinesiophobia	Moderate (c)	Good	Fear of movement and or re-injury, fear avoidance believes
SPADI	Yes (d)	Moderate	Self-experienced pain and disability

(a) Kvåle et al. 2003 (b) Margolis et al., 1986 (c) Haugen et al., 2008 (d) Ekberg et al., 2008.

### 3.4 Data collection

All the generated data was written down by one of three physiotherapists on a standardized trial-form and collected after each testing. The answered questionnaires were attached to the trial-form (attachment 1) belonging to the patient involved and coded without information to maintain the anonymity. These were kept together during the trial and will be destroyed after the study is finished in December 2014.

### 3.5 Analysis

The data set was analysed for statistical significance by Statistics Program for Social Sciences (SPSS) version 22 and was tested for normal distribution. The statistical tests used for normal distribution were the Kolmogorov-Smirnov test and the Shapiro-Wilk. Pearson's statistics was used to examine correlations. The strength of the correlation coefficient ( $r$ ) ranges from -1, being strongly negative correlation, to +1, being strongly positive correlation. A p-value of  $<0.05$  was considered statistically significant.

Data is presented as mean with Standard Deviation (SD), using Microsoft Office Excel and Word 2013.

### 3.6 Ethical considerations

The greatest ethical consideration in this trial is the use of human participants. The safety and well-being of the patient always has first priority and the study was conducted in accordance with the Helsinki-do-good convention. An official application was sent to the Norwegian Ethical Commission (REK), who gave their approval of this study in April 2014 (attachment

6). The tests are not invasive or harmful in any way, and each examination took approximately a maximum of 10-15 minutes.

#### 4. RESULTS

Of the 33 patients tested, three were excluded as they did not meet the inclusion criteria for this study and of the remaining 30 patients, eight did not want to participate as shown in Figure 2. The mean age was 49.1 years (SD 1.1) and 59 % were female and 40 % male. Further demographics are shown in Table 2.

Table 2. Presentation of the population studied (n = 22) as mean with standard deviation (SD), percentages or numbers of participants.

	Female	Male	Mean All	Min - max
Gender	13 (59 %)	9 (40 %)		
Age (years)	48.3 (7.9)	50.3 (10.8)	49.1 ( 9.4)	26 - 64
100 % at work	6 (27 %)	5 (23 %)	(50 %)	
With Medication	6 (24 %)	4 (18 %)	(45 %)	
Without medication	7 (32 %)	5(23 %)	(54 %)	

The results of the total scores of the GPE-Movement, TSK, Pain drawing and SPADI are shown in Table 3. In spite of the low number of participants (n = 22), the data had a normal distribution when using the statistical tests Kolmogorov-Smirnov test (p = 0.200) and Shapiro-Wilk (p = 0.480).

Table 3. Total mean scores per test.

Test N=22	GPE-Movement	TSK	PD widespread	SPADI
Results	10 (SD 3.6)	28 (SD 6.1)	36 %	23.8 (SD 12.3)

The Pain Drawing (PD) shows the percentage of the population having widespread pain.

#### 4.1 Movement aberrance, pain and disability in patients diagnosed with SIS

In Table 4 the results of the GPE-Movement tests and the SPADI are shown when categorized into the defined groups of Little/Normal, Moderate or High aberrant/pain/disability. In this study, 64 % were categorized as having highly aberrant general movements, and 32 % were moderately aberrant. The subdomain GPE Passive Movement had the highest percentage with



high scores, whereas 95 % (21 persons) had either moderate or high scores in the subdomain Flexibility. The SPADI showed that 77.3% of the population scored within Normal, and there were no scores in the High category.

Table 4. Tests scores presented as mean score with SD and percentage of the total population (n=22).

Test	Little /Normal Mean (SD), %	Moderate Mean (SD) , %	High Mean (SD), %
GPE-Movement total	4.2 (0.1), 9 %	7 (0.8), 32 %	11.6 (2.6), 64 %
GPE Flexibility	2.7 (0), 4.5 %	4.9 (0.6), 41 %,	7.4 (1.1), 55 %
GPE Passive Movem.	1 (0.6), 18 %	2.4 (0.6), 18 %	5.1 (1.5), 64 %
SPADI Total	12.6 (6.4), 77 %	42.8 (8.2), 23 %	(0)
SPADI Pain	21.3 (12.4), 18 %	51.8 (10.6), 64 %	73.4 (7.8), 18 %
SPADI Disability	22.8 (8.9), 54 %	44.3 (13.4), 36 %	72.9 (n = 1), 4.5 %

The scores are categorized into groups of little, moderate or high movement aberrance and category of pain intensity and dysfunction. The table list GPE Movement and the two sub-domains Flexibility and Passive Movement, SPADI, and the two domains Pain and Disability.

#### 4.2 Fear avoidance believes in SIS patients

The mean TSK score was 28 (SD 6.1), whereas the highest score shown was 43 and the lowest was 18 of possible 52 points (see table 3 and 5). A majority of this population with SIS had high fear avoidance believes. Thirteen people of the population (n=22) scored higher than the chosen cut-off point of 28, defined as positive for fear avoidance.

Table 5. TSK scores with SD.

Participants	Percentage	Mean score
Positive for fear avoidance	59 %	34 (4.1)
Negative for fear avoidance	41 %	24 (3.4)

#### 4.3 Localized or widespread pain in patients with long-lasting SIS

For the Pain Drawing the mean result for categorization into having localized or widespread pain is shown in Table 6. The majority of the population had local pain in the affected shoulder

region, but 36 % of the participants marked the drawing both above and under the line marked at 12 thoracic vertebra and were categorized as having widespread pain. One individual marked 40 squares (36 %) and that was the highest score out of 116. The rest of the population ranged from 1 % to 17 % with marked squares.

Table 6. Widespread and localized pain in participants based on the pain drawing test.

Test	Widespread Pain	Localized pain
Pain Drawing	8 (36 %)	14 (64 %)

#### 4.4 Association between movement aberrations and fear- avoidance in patients with SIS

There was no significant correlation between the different scores of the GPE tests and the TSK, as shown in Table 7.

#### 4.5 Association between movement aberrations and self-reported shoulder pain and dysfunction (SPADI)

There were no significant correlation (Pearson's  $r$ ) between the total GPE Movement scores and the SPADI Total score ( $p=0.646$ ), as shown in table 7 and figure 4. The subdomain GPE Passive movement and dimension Pain in SPADI correlated significantly ( $r=0.45$ ,  $p=0.034$ ).

Table 7. Correlation coefficients (Pearson's  $r$ ) and various test.

Tests	GPE Movement Total	GPE Flexibility	GPE Passive movement
TSK	$r=0.07$ ( $p=0.758$ )	$r=-0.07$ ( $p=0.731$ )	$r=0.14$ ( $p=0.520$ )
SPADI Total	$r=0.10$ ( $p=0.646$ )	$r=0.02$ ( $p=0.924$ )	$r=0.07$ ( $p=0.738$ )
SPADI Pain	$r=0.05$ ( $p=0.410$ )	$r=0.15$ ( $p=0.312$ )	<b><math>r=0.45</math>, (<math>p=0.034</math>)</b>
SPADI Function	$r=0.00$ ( $p=0.982$ )	$r=0.01$ ( $p=0.948$ )	$r=-0.02$ ( $p=0.902$ )

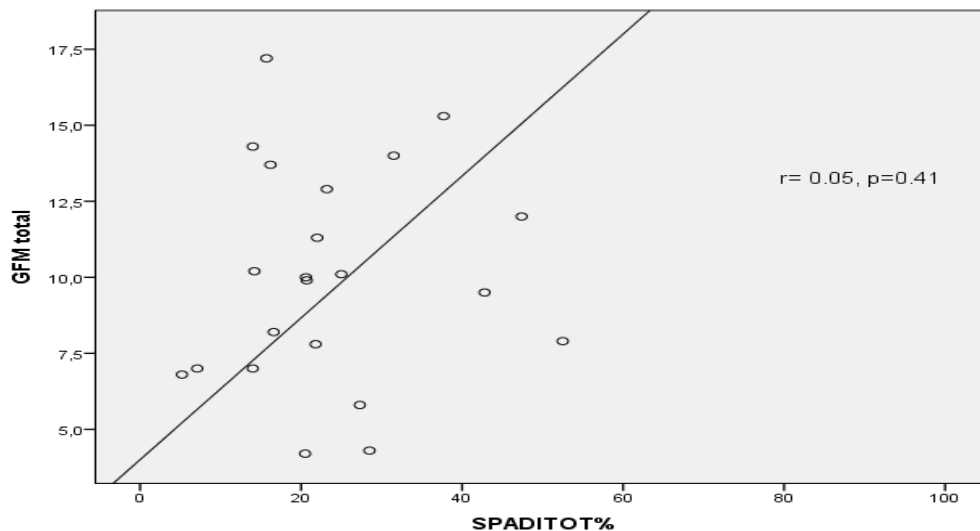


Figure 4. Correlation of total GPE score and total SPADI score. There was no significant correlation.

## 5. DISCUSSION

The main objective of this study was to explore the presence of general movement aberrations and fear of movement, and to discuss the possibility that patients with long-lasting SIS can have a more widespread problem than just the local pathologies. Due to the low number of participants and the design of the study no conclusions can be drawn, but some interesting trends were observed. This patient group diagnosed with long-lasting SIS had a clear tendency to have general movement aberrations, as 64 % were categorized as having high aberrance measured with GPE-Movement. Furthermore, all but one patient had moderate to high scores in the Flexibility sub-domain, indicating reduced flexibility of the spine as well as in the shoulder region. When it comes to fear of movement, 59 % scored positive on the TSK, but no association was found between movement aberrations and fear avoidance beliefs. There was no correlation between the aberrations and self-reported pain and function, except between GPE Passive movement and SPADI Pain ( $p < 0.05$ ). Widespread pain was only present in 36 of the subjects.

### *5.1 Presence of movement aberration in the SIS population*

The most interesting finding in this study is the high scores in the GPE Movement tests, indicating a presence of aberrations. All together 91 % of the patients had moderate to very

high movement scores, i.e. a total score  $> 4.9$  points, and  $> 3.1$  in Flexibility and  $> 1.9$  in Passive movement. In the study of Kvåle et al. (2003), healthy subjects were found to have mean values of 3.0 (SD 1.5) in the subdomain Flexibility and 1.8 (SD 1.2) in the subdomain Passive movement. In this study, less than 10% had scores equivalent to that healthy population. This patient group with SIS had a total GPE Movement score with a mean of 10 points (SD 3.6), twice as much as found in healthy persons before, which indicates the presence of aberrant movement. Kvåle et al. (2003) saw that people with widespread pain were more aberrant compared to people categorized with localized pain. However, in this study the majority of patients with long lasting SIS had localized pain, but still had a high degree of movement aberrations. The GPE do not only test for aberrations locally at the shoulder, but include examination of flexibility and ability to relax in the arm, shoulder, thorax, spine and lower extremity, that overall was highly aberrant in 64 % of this population with long lasting SIS complaints. Their perception of pain was low to moderate and expectantly should not give aberrations in general movements to this extent, unless there are other physiological factors playing its part. Fear of movement could generate general movement aberrations and might be a perpetuating factor for the disorder. Therefore, these results could indicate the possibility that there is a presence of a sensitization process and if persisting for a longer period the sensitization process could cause SIS to become more widespread, as seen when tested physically.

### *5.2 Fear avoidance believes in patients with SIS*

Originally the fear avoidance model was highly hypothetical, but in the last decade it has changed to be a well justified theory (Crombez et al., 2012). This psychological factor expresses the fear for re-injury or movement, as seen in patients after an operation to the Anterior Cruciate Ligament (ACL) (Kvist and al, 2005). In the study by Kvist et al. (2005), there was no limit set as to who were fear avoidant, but they found that 28 % of the population reported fear for re-injury as the reason not to return to their sport. The mean score of TSK in their patients group (n=47) was low, with 17 points out of a maximum possible of 51 points. Cheung et al. (2013) used in their study with neck patients, 37 points on a 17 item TSK, to define the patient as fear avoidant. This limit is equivalent to the 28 points used in this study on a 13-item TSK. Noteworthy, there was no significant relation between physical activity and fear of movement in the patient group studied by Cheng and co-workers. The neck patients had a mean score of 37.6 (SD 5.8) of fear avoidance (Cheung et al., 2013). The results are the same as in this study, where the mean score was 28 (SD 6.1), which is on the borderline between being fear avoidant

or not. The majority (59%) in this SIS patient group had high fear avoidance beliefs, having a total score  $> 28$  of the TSK. When comparing the mean TSK scores of 26.1 points (SD 7.8) in the study of patients with non-traumatic arm, neck and shoulder dysfunction by Feleus et al. (2007) (17 items), the mean score was somewhat higher (34 (SD 4.1)). This comparison reveals that the scores are high in this studied shoulder population, but not contradicting or unexpected to prior results in patient groups with long lasting pain (Crombez et al., 2012).

A physiotherapist and an occupational therapist informed the patients about the possible aetiology and management strategies of shoulder problems at a general information meeting prior to the testing. Because this information meeting was also used to inform about the present study, the testing was done after this meeting. When going through the TSK-questionnaires some interesting observations were made that could have influenced how they scored. Several statements in the test reflect the thoughts of using the shoulder without fear for the pain or re-injury, but at the meeting, the importance of using the shoulder in a normal (pain-free) way and doing the prescribed exercises was emphasized. Seemingly, a large percentage (73-95 %) confirmed what was taught that day when answering the TSK and could reflect upon what was advocated at the clinic in how to go about a painful shoulder in the daily activities. The results might have given a higher score of fear avoidance if the testing had been prior to the information meeting.

### *5.3 Pain Drawing and degree of widespread pain in patients with SIS*

In the population of this current study only 36 % had signs of widespread pain according to the body drawing. This concurs to other studies done in patients with shoulder complaints, though only a few studies have investigated the presence of widespread pain in shoulder patients by using the Pain Drawing. Hayashi et al. (2014) used the pain drawing to differentiate between organic or non-organic pain in patients with chronic neck and shoulder complaints. The intent was different from seeing if the pain was widespread or not, but the conclusion was that the area of complaints was determinant to which characteristics a patient have. In their study a mean of 18 % were categorized for having non-organic pain. Furthermore, 26 % of their patients, with organic pain and the patients with non-organic pain, were associated with having psychological disturbances (Hayashi et al., 2014). Dyrehag et al. (1998) used a pain drawing of the complete upper body including the lumbar region in their population of patients with chronic neck and shoulder complaints. When testing this population for symptoms, signs and psychological distress, the mean percentage covered was 40 % of the Pain Drawing, and 36 %

reported additional pain in the lumbar region (Dyrehag et al., 1998). The population with SIS in this study had marked pain in number of squares ranging from 1 % to 36 %, with a mean of 9 %, which is low, compared to the results of Hayashi et al. (2014) and Dyrehag et al. (1998). Of the patients who also had marked pain below the line at Th 12, 36 % were classified as having widespread pain.

A reason for a more localized pain expression on the Pain Drawing form could have been the sequence of the questionnaires. The Pain Drawing was filled in after the SPADI, where the patient had marked a VAS score line with an X. In this study, all but one (97 %) marked the drawing with an X. Had the sequence of the questionnaires been different, the patient might have interpreted the way of answering differently. This could have led them to shade a more extensive area of pain. Marking it with an X can have influenced the results to a lower percentage and possibly explain a more modest pain-expression than expected.

Another reason for the small area marked with pain could be the influence of medication or that the patient had received a cortisone injection prior to the testing, as 45 % of the population were registered as being influenced by medication.

#### *5.4 Shoulder pain and function*

The self-reported pain and disability results were rather peculiar as they did not correlate with the GPE tests (see table 7) and the scores on SPADI were rather low.

Kumta et al. (2012) showed a high correlation between a functional test of the arm and hand and the SPADI, whilst Roach et al. (1991) found a highly negative correlation between functional ROM and the SPADI (Roach et al., 1991; Kumta et al., 2012). More research confirms that there is no correlations between physical tests and self-report questionnaires as Waddell et al. (1992) and Aure and Kvåle (2012) found in their patients with low back pain (Waddell et al., 1992; Aure and Kvåle, 2012).

The higher the scores the more pain and disabilities the patient experience. In this study, the majority of the population (77 %) had scored Little / Normal of the total score on SPADI and there were none with a high score, i.e. high degree of pain and disability. Kromer et al. (2013) had in their study a mean total-score of 40.4 points. Comparing those score to the mean of the total SPADI score in this study, 23.8, the score in this study are low. When looking into the two dimensions of SPADI, 63 % of the population scored Moderate pain (mean of 48.4) and only 18 % High, the highest score was 79.6 points. This could imply that the pain in this sample of

patients with long-lasting SIS was not dominating and had a restricted influence on the High aberrance movement scores reflected in the GPE total score. This is confirmed by the lack of correlation as shown in Table 7. ( $r=0.05$ ,  $p=0.410$ ). The lack of correlation could be due to the lack of correlation between patients' perceived disabilities and functional tests, as reported in former studies (Waddell et al., 1992; Aure and Kvåle, 2012).

However, there was a significant correlation between the SPADI pain dimension and GPE Passive movement ( $r=0.45$ ,  $p=0.034$ ). The GPE Passive movement tests the ability to relax and subdue to pendular movements. Though having low to moderate pain (82 %), these subjects were not able to relax sufficiently and allow to be tested in the passive movements. As described earlier, the subconscious fear for re-injury and pain can result in a hyper vigilant state making the muscle tone increase. When the expectancy of pain is present, passive movement by the therapist can be seen as a threatening movement (re-injury) and result in this subconscious aberrance even though the pain is low to moderate.

## *5.5 Methodical Considerations*

### *5.5.1 Internal validity*

A cross sectional study as this one, collects data at one point in time. That means it generates data without maturation of the population or the influences of technological or social changes in a society. This design is especially equipped to describe the status of, or a relationship to a phenomenon at a fixed point (Polit and Beck, 2006). To ensure the highest possible research validity the construct of this study was carefully considered and the researcher was blinded to all testing to assure as little bias as possible, and received the filled in questionnaires after completion.

It was the first time that the three physiotherapists used the GPE test and could have resulted in scoring differently than more experienced therapists. Therefore, to ensure a calibrated test result major effort was put in the preparations prior to the study.

Lessons were given from an experienced therapist to the researcher who taught it on to the three therapists. This was done five times to calibrate and to ensure the validity and reliability. Having three therapists to do the GPE will give different results than only one. None of them had experience in doing this test and the working experience varied from therapist A, who had two years and therapist C who had 17 years of experience. This could have affected the results due to the difference in experience of interpreting passive movement and resistance. Most likely the

older therapists will know better what is normal movement compared to one with less experience.

This being a cross-sectional study the factor time did not play a hand, but the timing might have influenced the result. Doing the testing after the information meeting may have influenced the results of the questionnaires (Domholt et al., 2005) as the participants could respond to what has been told in the meeting about how to move and go about with the painful shoulder, reducing beliefs and fears they might have had for using the arm.

Another internal validity bias is the sequence of the questionnaires. The Pain Drawing form came after the SPADI questionnaire which asks the participants to mark a line with an X where the patient perceive the pain. When filling in the Pain Drawing, it is expected to shade in the squares where the pain is. This population crossed it off when marking the area of the pain, giving a possible derived result.

Based on the scores from the Kvåle et al. study (2003) the categorization of the GPE scores were made as normal, moderate and highly aberrant. In this process, people might have been put into the wrong category since the standard deviation not was taken into account when making the categorization. When looking at the boarder lines of the categories there were, however, no clustering of the results that imply that the categories should have been differently.

### *5.5.2 External Validity*

Taking into account the experimenter expectancy, which is when the participant can guess what the experimenter wants them to answer, the testing was only done once and not considered a threat to the construct validity (Domholt et al., 2005). Though doing the tests after the information meeting could have led to answering the TSK questionnaire based on what they have just learned about shoulder complaint management.

When asked to participate in this study several patients declined (8 out of 33). This could alter the outcome and make the population less generalizable. The patients were diagnosed with SIS and therefore the results are not transferable to patients with general shoulder complaints.

### *5.6 Therapeutic Considerations*

This study shows that patients diagnosed with SIS with long-lasting pain, could have a more wide spread problem when it comes to the findings of the GPE test. As a manual therapist, the



intent is to treat local problems, but also to address perpetuating factors at hand. Therefore, when treating patients with long lasting SIS it should be taken in consideration that these general aberrations is a wide spread problem and needs to be treated there as. However, this still needs to be verified by doing further research.

## 6. CONCLUSION

### *6.1. Implications for Practice*

As the results showed, there is a general high degree of movement aberrations and a presence of fear avoidance beliefs in this population with long lasting SIS. Only a small proportion showed signs of widespread pain, but the degree of movement aberrations and the presence of fear avoidance can suggest that SIS is not only a local problem, but that coping strategies and the ability to relax and move normally is poorer in this population with long lasting problems.

Psychological distress can present itself as physical symptoms and the fear for pain and movements can be a part of a sensitization process and predict a less successful treatment outcome and be a part of a more widespread problem. Sensitization of central mechanisms combined with the pain cognition could result in vigilance to movement and the vicious circle, as presented by Leeuw et al. (2007) (Figure 1) has commenced.

Treatment strategies can fail if these factors are not addressed properly and could become a perpetuating factor. It could also be a reason to why shoulder complaints can be long lasting and why there is a general poor outcome in treatment. To break this vicious circle, treatments that address the way of moving, ability to relax, and reduce the fear of moving might be an answer. The effect of such an approach, however, can only be studied in a longitudinal study, preferably in a RCT.

### *6.2. Implications for Research*

This study is merely a start as to what needs to be investigated concerning the influence of fear avoidance beliefs, movement aberrations, and presence of widespread pain in a patients diagnosed with SIS. Is negative coping strategies of influence in the SIS complaints and what does this population have and to what degree?

Further research need to shed light onto the process as to when patients develop fear avoidance beliefs and aberrations in movement. More should be done to study the phenomenon of shoulder

dysfunction as a possible more general and widespread problem, not merely as the possible pathologies of the tissues surrounding the shoulder.

Another manor of studying this syndrome is advised, rather than the use of the cross-sectional method, who inevitably cannot separate cause and effect. The choice should fall on a method that could untangle the various dominating factor i.e. fear of or movement, depression, aberrations, psychosocial distress or widespread pain in a patient, and to what degree it plays a part in the prognostic process and to determine what therapy best suited.

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## Attachements

Attachement 1, standardized result form

### **Resultat skjema**

Deltaker nummer: \_\_\_\_\_

Dato: \_\_\_\_\_

Kjønn : \_\_\_\_\_

Resultat SPADI: \_\_\_\_\_

Resultat GFM-52 bevegelser: \_\_\_\_\_

Resultat smertetegning: \_\_\_\_\_

Resultat TAMPA: \_\_\_\_\_

Smertestillende: \_\_\_\_\_



## Attachment 2, GPE- Movement

### Test 3.1 Flexibility



#### *Test 44. Shoulder retraction*

Patient: In standing position

Physiotherapist: Behind the patient on the left side

Execution: One hand is placed underneath the scapula inferior angle to prevent rotation of the trunk and to stabilize the patient. The left hand is put in front of the shoulder and with the fingers the shoulder is retracted in the line with the fibres of the m. pectoralis major to so be gently let go of. The patient is informed of what is going to happen, and the resilience of the passive movement and the movement of the arm as the shoulder falls back to position is evaluated.



#### *Test 45. Lumbar-sacral passive movement leaning forwards*

Patient: Is leaning towards the wall with the buttocks and the feet of the wall and a bit separate.

The patient is asked to lean forwards and hanging relaxed with the arms towards the floor.

Therapist: Stands on the left side with the whole palm and fingers slightly spread on the sacral lumbar junction with the finger pointing towards the head of the patient.

Execution: The patient is told what is going to happen as the therapist gives a firm but gentle rhythmical pressure upwards allowing a movement to occur of the spine, arms and head. The resilience towards the movement and the bobbing movement made of the arms and head is evaluated.



*46. Passiv nodding of the head in flexed position.*

Patient: Is leaning towards the wall with the buttocks and the feet of the wall and a bit separate.

The patient is asked to lean forwards and hanging relaxed with the arms towards the floor.

Therapist: Is standing on the left side of the patient with the three middle fingers, a bit apart from each other, on the occipital rim, with only the fingers touching the patient.

Execution: The patient is prepared of what is going to happen as the therapist nods the head passively forward. The resilience to the passive movement and the bobbing of the head is evaluated.



*Test 47. Passive rotation of the head in forward leaning position*

Patient: Is leaning towards the wall with the buttocks and the feet of the wall and a bit separate.

The patient is asked to lean forwards and hanging relaxed with the arms towards the floor.

Therapist: is standing on the left side of the patient with the right hands fingers spread over the back of the head.

Execution: Prepare the patient as to what is going to happen. The therapist rotates the head to the right and left gently but firm. The resilience to the passive movement of the rotation is evaluated.

### 3.3 Passive movement



#### *Test 43. Elbow release*

Patient: Is standing upright.

Therapist: Stands on the left side of the patient, lift the elbow to 90° abduction in the shoulder and 90° flexion in the elbow. The elbow and the hand of the patient rests in the hands of the therapist.

Execution: prepare the patient as to what is going to happen. Let the elbow fall down passively as the hands remain joined together. The movement of the arm is evaluated as it falls downwards.



#### *Test 57. Passive hip rotation with flexed knee*

Patient: Is laying supine.

Therapist: Is standing on the left side of the patient. One hand is on the left shoulder and the other hand is embracing the left knee.

Execution: The patient is informed of what is going to happen. The therapist bends the knee and moves the hip in a rotation, beginning outwards, with a calm, rhythmical, but firm movement. The response to the passive movement is evaluated.



*Test 63. Passive elevation of the extended arm*

Patient: Lays supine.

Therapist: Stands on the left side of the patient.

Execution: The patient is informed of what is going to happen. The therapist holds the arm gently by the wrist with the left hand and lifts the arm towards full flexion with a gentle pull of the arm. At 90° flexion, the grip is exchanged to the other hand of the therapist continuing the movement to full flexion. The response to the passive movement is evaluated.



*Test 62. Passive pressure on the thorax*

Patient: Laying supine.

Therapist: At the left side of the patient at the level of the patients thorax.

Execution: The patient is told what is going to happen. Then the therapist lay the two hands with fingers apart on the thorax. The thumbs aligned with the arch of the rib cage and the little fingers on the lower part of the rib cage. With a little body weight, firm but gentle pressure is exercised on to the ribcage in a caudal, medial and dorsal direction with extended elbows. The resilience to the pressure and movement is evaluated.

### Attachment 3. Tampa scale of Kinesiophobia

#### ”TAMPA”

#### Spørsmål om smerte og fysisk aktivitet

Vennligst svar på de følgende spørsmål. Svar i forhold til dine egne følelser, ikke i forhold til hva andre synes du skal mene.

Sett ring rundt det tallet ved siden av hvert spørsmål som best tilsvare dine følelser.

	SVÆRT UENIG	LITT UENIG	LITT ENIG	SVÆRT ENIG
1. Folk tar ikke min medisinske tilstand alvorlig nok.....	1	2	3	4
2. Kroppen forteller meg at noe er alvorlig galt.....	1	2	3	4
3. Skaden har gjort at kroppen min vil være utsatt resten av livet.....	1	2	3	4
4. Jeg er redd for at jeg kan skade meg ved et uhell.....	1	2	3	4
5. Smertene ville blitt verre hvis jeg hadde prøvd å overvinne dem.....	1	2	3	4
6. Det sikreste jeg kan gjøre for å hindre at smertene blir verre, er å unngå unødvendige bevegelser.....	1	2	3	4
7. Jeg ville ikke hatt så mye smerte hvis det ikke foregikk noe potensielt farlig i kroppen min.....	1	2	3	4
8. Smerter betyr alltid at jeg har skadet kroppen.....	1	2	3	4
9. Smertene sier fra når jeg skal stoppe treningen, slik at jeg ikke skader meg.....	1	2	3	4
10. Det er faktisk ikke trygt for en person med min tilstand å være fysisk aktiv.....	1	2	3	4
11. Jeg er redd jeg kan komme til å skade meg hvis jeg trener.....	1	2	3	4
12. Jeg kan ikke gjøre alle de tingene folk flest gjør, fordi jeg har så lett for å bli skadet.....	1	2	3	4
13. Ingen burde være nødt til å trene når han eller hun har smerter.....	1	2	3	4

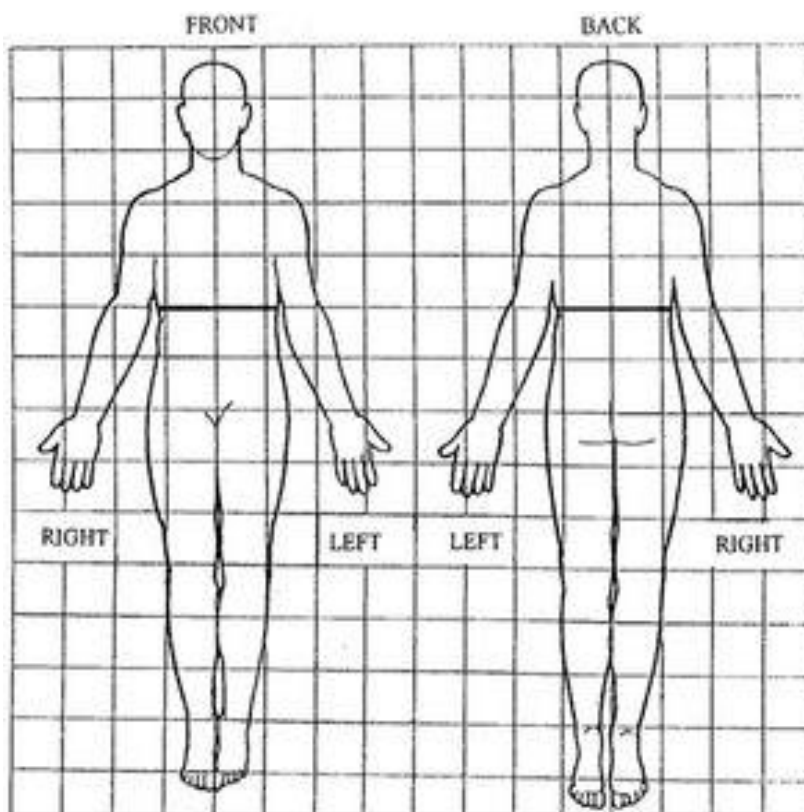
(The Tampa scale. Kori, Miller & Todd

oversatt av Haugen, AJ og Grøvle L 2004)

Attachment 4, Pain drawing

Dato: \_\_\_\_\_ Pasientnr.: \_\_\_\_\_

Merk av hvor du har kjent smerter i kroppen de siste 14 dagene.



## **SPADI**

# **Shoulder Pain and Disability Index**

**Norsk versjon**

Roach KE et al. **Development of a shoulder pain and disability index.** *Arthritis Care and Research* 1991, **4**(4):143-149.

## Spørreskjema om vond skulder

Del I: Sett et merke på linjen for å vise hvor sterke SMERTER du har hatt den siste uken for hvert spørsmål

Eksempel: Ingen smerter _____ X _____ Verst tenkelige smerter
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1. På det verste? Ingen smerter \_\_\_\_\_ Verst tenkelige smerter

2. Når du lå på den vonde siden? Ingen smerter \_\_\_\_\_ Verst tenkelige smerter

3. Når du strakte deg etter noe på en høy hylle? Ingen smerter \_\_\_\_\_ Verst tenkelige smerter

4. Når du tok på nakken? Ingen smerter \_\_\_\_\_ Verst tenkelige smerter

5. Når du skjøv med den vonde armen? Ingen smerter \_\_\_\_\_ Verst tenkelige smerter



Del II: Sett ett merke på linjen for å vise hvor store VANSKER du har hatt **den siste uken** når du utførte aktivitetene som er opplistet nedenfor

1. Når du vasket håret?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp

2. Når du vasket deg på ryggen?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp

3. Når du tok på deg undertrøye eller genser?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp

4. Når du tok på deg en skjorte med knepping foran?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp

5. Når du tok på deg buksene?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp

6. Når du plasserte en gjenstand på en høy hylle?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp

7. Når du bar en tung gjenstand på 5 kg eller mer?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp

8. Når du tok opp noe fra baklomma?

Ingen vansker \_\_\_\_\_ Så vanskelig at jeg måtte ha hjelp



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<b>Region:</b>	<b>Saksbehandler:</b>	<b>Telefon:</b>	<b>Vår dato:</b>	<b>Vår referanse:</b>
REK nord	Øyvind Strømseth	77620753	11.06.2014	2014/688/REK nord
			<b>Deres dato:</b>	<b>Deres referanse:</b>
			02.06.2014	

Vår referanse må oppgis ved alle henvendelser

XXXXXXXXXXXX

Inst. for Global Helse og Samfunnsmedisin, Kalfarveien 31

### 2014/688 Subacromial smertesyndrom - lokalt eller utbredt?

**Forskningsansvarlig:** Universitetet i Bergen

**Prosjektleder:** XXXXXXXXXXXXXXX

#### Prosjektomtale

Målet med denne masteroppgave-prosjektet er å kartlegge forekomsten av utbredte smerter og bevegelsesforstyrrelser hos skulderpasienter diagnostisert med langvarig (> 12 uker) Subakromialt Inneklemmings Syndrom (SIS), og å undersøke om grad av skuldersmerter og dysfunksjon er assosiert med mer generelle bevegelsesforstyrrelser og smerteutbredelse. Hypotese: Det er bare lokalisert smerte og funksjonelle begrensninger i skulder regionen hos pasienter med langvarig SIS. Data skal registreres på pasienter som er henvist til en tverrfaglige spesialistklinikk ved XXXXXXXXXXXXXXXXXXXX kommer til fysioterapeuter. Testbatteriet er delvis standard prosedyre for fysioterapeutene på klinikken men vil også inneholde to et spørreskjema og en klinisk Global Funksjon og Muskelundersøkelse (GFM) Dataene vil bli avidentifisert med en kode, og deretter underkastet statistisk analyse. Denne koden vil bli destruert ved prosjektperiodens slutt og senest 30.12.2014

Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK nord) i møte den 8.5.2014. Komiteen hadde merknader til søknaden og fattet utsettelsesvedtak hvor den videre behandling av søknaden vil bli foretatt på fullmakt av komiteens leder/nestleder og sekretær med mindre det reises spørsmål som må behandles av samlet komité. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10, jf. forskningsetikklovens § 4.

Prosjektleder har gitt tilfredsstillende tilbakemelding på komiteens merknader den 2.6.2014.

#### Vedtak

Med hjemmel i helseforskningsloven § 10 og forskningsetikkloven § 4 godkjennes prosjektet.

#### Sluttmelding og søknad om prosjektendring

Prosjektleder skal sende sluttmelding til REK nord på eget skjema senest 30.04.2015, jf. hfl. § 12. Prosjektleder skal sende søknad om prosjektendring til REK nord dersom det skal gjøres vesentlige endringer i forhold til de opplysninger som er gitt i søknaden, jf. hfl. § 11.

#### Klageadgang

Du kan klage på komiteens vedtak, jf. forvaltningslovens § 28 flg. Klagen sendes til REK nord. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK nord, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

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**Besøksadresse:**  
MH-bygget UiT Norges arktiske  
universitet 9037 Tromsø

**Telefon:** 77646140  
**E-post:** rek-nord@asp.uit.no  
**Web:** <http://helseforskning.etikkom.no/>

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

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

# Forespørsel om deltakelse i forskningsprosjektet *”Subacromialt impingement syndrom, et lokalt eller sentralt problem”*

## **Bakgrunn og hensikt**

Dette er et spørsmål til deg om å delta i en forskningsstudie for å se hvordan skulder problematikken din har påvirket smerte og bevegelsesevne. Siden dine skulder problemer har vedvart over lengre tid faller du innenfor målgruppen for denne studien.

Studien blir gjort i regi av Universitet i Bergen og Stavanger Universitets Sykehus og er en del av master studium i manuellterapivitenenskap.

## **Hva innebærer studien?**

Studien er en tverrsnitt studie hvor vi bruker velprøvde og standardiserte undersøkesskjema på et gitt tidspunkt. Disse inkluderer en standardisert klinisk undersøkelse kalt GFM og to spørreskjema som heter Smertetegning, SPADI og Smerter og Funksjonalitets skjema Ingen av undersøkelsene gir smerter eller er provoserende på noen måte. Den kliniske undersøkelsen vil bli utført av fysioterapeuter.

## **Mulige fordeler og ulemper**

Til nå er det ingen kjent risiko eller ulemper eller fordeler ved å delta i denne undersøkelsen. Å svare på spørreskjemaene men krever ikke mer enn max 15 minutter av deres tid og deltakelsen i studien er ikke forbundet med noen helserisiko. Etter testing vil konsultasjonen fortsette som på vanlig måte.

## **Hva skjer med informasjonen om deg?**

Informasjonen som registreres om deg skal kun brukes slik som beskrevet i hensikten med studien. En kode knytter deg til dine opplysninger og prøveresultat gjennom en navneliste. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennerende opplysninger i de statistiske analysene som skal gjennomføres. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.

Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som evt. kan finne tilbake til deg. Sletting av innsamlede data vil skje etter at studien har blitt avsluttet i oktober 2014.

## **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 behandlingen av dine

skulderplager. 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 senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte xxx på telefon eller via email..

## Samtykke til deltakelse i studien

Jeg er villig til å delta i studien

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(Signert av prosjektdeltaker, dato)

Stedfortredende samtykke når berettiget, enten i tillegg til personen selv eller istedenfor

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(Signert av nærstående, dato)

Jeg bekrefter å ha gitt informasjon om studien

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(Signert, dato)