
Shoulder pain and disability is a common clinical problem with an annual prevalence rate reported to range from 4.7% to 46.7% across age groups. Outcome studies of shoulder disorders demonstrate that symptoms and disability often persist despite conservative treatment. Despite the prevalence and risk of disability associated with shoulder pain, there are few quality studies providing evidence to guide treatment of this patient population.

During the years 1993-2000, a reported 23.9% of patients presenting to US primary care physicians with complaints of shoulder pain were referred for physical therapy. Physical therapy management of shoulder pain commonly consists of a variety of interventions, including manual therapy, exercises, physical agents, and numerous electrotherapeutic and mechanical modalities. In a recent review of physical therapy interventions for shoulder pain, the authors concluded that there is limited evidence supporting the efficacy of treatment. The lack of consistently applied diagnostic classifications is recognized as a factor limiting the ability to effectively interpret relevant research.

The lack of consensus in diagnosing shoulder disorders may be related to the complexity of factors influencing shoulder function. It has been suggested that shoulder pain is potentially referred from a variety of musculoskeletal sources, including the shoulder complex (structures of the glenohumeral joint, acromioclavicular joint, scapulothoracic joint, and subacromial space), the cervical spine, and the elbow. Nonmusculoskeletal sources, including the lungs, heart, diaphragm, gallbladder, and spleen, are also recognized as potentially referring pain to the shoulder.

Screening for medical disease is essential in identifying the possibility of systemic disease contributing to pain and disability of the shoulder. A case report by Walsh and Sadowski reviewed theorized mechanisms of referred shoulder pain from nonmusculoskeletal sources and described a specific case of diaphragmatic disease possibly contributing to shoulder pain and disability.

There is also evidence suggesting that impairments of the cervical spine and upper limb neural tissue may contribute to shoulder pain and disability. Structures of the cervical spine, including the facet joints and cervical dorsal rami, have been...
The contribution of upper limb neural tissue to shoulder pain is based on the concept of neural tissue mechanosensitivity, which relates to the response of neural tissue to mechanical stimuli. Several studies have demonstrated an increase in tension and excursion of neural tissue in response to head, neck, and upper limb movements. Increased mechanosensitivity of neural tissue may be influenced by factors such as altered ion channel activity, ischemia, axoplasmic flow, and the physical health of neural connective tissue.

Studies investigating the role of manual therapy in the management of shoulder disorders have suggested that addressing impairments of the upper quarter, including the cervical and upper thoracic spine, upper rib articulations, glenohumeral joint, and acromioclavicular joint. Studies analyzing the effect of cervical spine mobilization in patients with signs of increased upper limb neural tissue mechanosensitivity have also produced favorable outcomes. However, the varied inclusion criteria utilized in these studies make it difficult to draw a definitive conclusion regarding the utility of these interventions. Additionally, the manual therapy interventions utilized in these studies were directed at multiple sources, including the cervical and upper thoracic spine, upper rib articulations, glenohumeral joint, and acromioclavicular joint. Studies have demonstrated an increase in tension and excursion of neural tissue in response to head, neck, and upper limb movements. Increased mechanosensitivity of neural tissue may be influenced by factors such as altered ion channel activity, ischemia, axoplasmic flow, and the physical health of neural connective tissue.

The purpose of this case report is to illustrate a manual physical therapy management approach for a patient with shoulder pain and disability, specifically addressing impairments of the cervical spine and upper limb neural tissue believed to contribute to the patient’s symptoms.

**CASE DESCRIPTION**

**History**

The patient was a 45-year-old female research scientist with a primary complaint of right shoulder pain. She described her symptoms (P1 [primary complaint]) as an intermittent sharp pain felt deeply in the right anterior shoulder that limited her ability to use her right upper extremity for normal activities of daily living. Her symptoms varied in intensity, depending on activity. Specifically, she had functional limitations with reaching forward or overhead, donning and doffing her shirt, washing and brushing her hair, reaching behind her back, and using her stick shift while driving. She continued to work, but reported that use of a pipette during laboratory experiments aggravated her symptoms because it involved elevation (shoulder abduction) of the upper extremity. She was also unable to continue her regular exercise routine, consisting of light weightlifting utilizing 2.27-kg dumbbells. Once aggravated, her symptoms would ease within a few minutes of lowering her arm to her side. Additionally, she also described an intermittent dull, aching sensation in the area of the right scapula (P2 [secondary complaint]) that was present only when her anterior shoulder pain increased in intensity. The patient denied neck pain or stiffness, numbness, tingling, weakness, or radicular pain. The patient’s pain distribution is illustrated in the body chart (Figure 1).

The patient’s 24-hour symptom behavior was described as gradually worsening over the course of the day, with frequent sleep disturbances (2 to 3 hours of sleeplessness per night) related to position changes. The patient denied morning stiffness.

The patient attributed the onset of symptoms to going for a hike while wearing 1.36-kg wrist weights. She recalled hiking for approximately 2 hours at a fairly brisk pace. Symptoms were not experienced during the hike, but came on a few hours afterwards. The severity of her symptoms gradually increased over the next 2 days, prompting her to consult an orthopedic physician. The physician ordered plain radiographs of the shoulder, which were reported as normal. He then performed a subacromial corticosteroid injection (Triamcinolone plus 1.0% lidocaine and 0.5% marcaine). The patient reported no change in symptoms immediately following the injection. A referral for physical therapy was also made at this time, with a diagnosis of rotator cuff strain. The patient arrived for her initial physical therapy visit 9 days following the onset of symptoms and 7 days following the physician consult. She reported no change in her symptoms since the visit with her physician.

The patient’s goal was to return to her previous level of work and household activity without pain or impairment. She also hoped to resume her regular exercise program of light weightlifting.

**Examination/Evaluation**

**Medical Screening** Medical history screening was negative for disease or red flags suggestive of systemic pathology.

**Pain Intensity Level and Functional Status** The Shoulder Pain and Disability Index (SPADI) was administered at the beginning of the initial examination and each subsequent visit. The SPADI...
DIX) is a 13-item, self-administered questionnaire, with 5 questions comprising the pain domain and 8 questions comprising the disability domain. Responses to each item were recorded on an 11-point scale, where 0 is “no pain” or “no difficulty” and 10 is the “worst imaginable pain” or “so difficult it required help” for the pain and disability items, respectively. Based on its demonstrated validity, reliability, responsiveness, and ease of use, the SPADI has been recommended as a preferred shoulder-specific questionnaire. The SPADI score is calculated as a percentage, with 0% indicating no pain or disability and 100% indicating severe pain and disability. On initial examination, the patient’s total SPADI score was 83%.

**Observation/Posture** Posture was analyzed as described by Kendall et al. The patient exhibited a forward head posture and symmetrically abducted scapulae. There was no observed atrophy of the shoulder or scapular region musculature.

**Shoulder ROM** Shoulder active range of motion (AROM) was measured using a universal goniometer. Goniometric measurement of shoulder ROM has demonstrated fair to good reliability. Despite the questionable reliability of goniometric measurements, AROM testing was considered a useful tool for assessing immediate response to intervention. Based on a calculated standard error of measurement of 11° to 23° for intrarater goniometric measurement, relatively large increases in AROM were judged as being indicative of real change. Shoulder passive range of motion (PROM) was tested for the purpose of qualitatively assessing pain and resistance in relation to shoulder ROM. This determination of end feel has demonstrated high reliability. On initial examination, the patient demonstrated 50° of active shoulder flexion, with pain (P1) at end of range. Passive shoulder abduction to 45° and lateral rotation (measured in 0° of shoulder abduction) to 25° was limited by pain (P1) and muscle guarding. Testing of the uninvolved shoulder revealed 150° of active shoulder flexion, 90° of shoulder abduction, and 60° of shoulder lateral rotation. These motions were performed without pain.

**Isometric Muscle Tests** Resisted maximal isometric action of shoulder abduction, medial rotation and lateral rotation, and elbow flexion and extension was examined and graded as described by Cyriax. Testing of right shoulder abduction and lateral rotation was graded strong and painful. All other tests bilaterally were graded strong and painless. Although the reliability of these tests has been questioned, good diagnostic agreement was demonstrated when these tests were performed in the context of a thorough examination.

**Cervical ROM and Provocative Tests** Cervical spine ROM was evaluated through active motion tests and manual overpressure, as described by Maitland. Active motion was measured utilizing the Cervical Range of Motion (CROM) Instrument (Performance Attainment Associates, Roseville, MN). The CROM instrument has demonstrated high reliability and validity. Active motion in flexion, extension, bilateral rotation, and sidebending was normal and symmetrical, according to established normal values. All movements were cleared (no symptom reproduction) with overpressure. The Spurling test was performed, as described by Wainner et al, and found to be negative. This test has demonstrated utility as a screening tool for cervical radiculopathy.

**Neurological Tests** Conventional neurological testing of myotomal strength, dermatomal sensation, and muscle stretch reflexes was performed as described by Wainner et al. Manual muscle testing of the C5-T1 innervated muscles were graded 5/5. Sensory tests and muscle stretch reflexes were graded as normal and symmetrical. Although the sensitivity of these tests is low, they demonstrate relatively high specificity for diagnosing cervical radiculopathy, particularly when analyzed as a cluster. These tests may have utility as a screening prior to the potentially more provocative upper limb tension testing described below.

**Upper Limb Tension Test** The upper limb tension test (ULTT) is suggested to be a useful tool in the examination of upper limb neural tissue mechanosensitivity. The ULTT is not intended to diagnose a specific disorder, but instead be a useful tool in the examination and evaluation of a variety of neurogenic disorders. In patients with suspected cervical radiculopathy, the ULTT has demonstrated excellent reliability as operationally defined by Wainner et al. Upper limb tension testing has also been suggested as a test capable of discriminating local versus referred sources of upper limb pain. Hall and Elvey describe the use of the ULTT in the diagnosis of cervicobrachial pain syndrome.

A description of the performance and scoring criteria for the ULTT can be found in Table 1 and Figure 2. In addition to describing the test result as either positive or negative, ROM was examined and re-examined following each intervention. The ROM reported reflects the position of the last joint movement introduced that resulted in symptom reproduction. Although the reliability of such measurements has not been established, these quantitative measures allowed for the recognition of potential correlations to shoulder AROM measurements and functional outcome scores. On initial examination of the right upper extremity, a positive ULTT was noted, with pain (P1) reproduced at 45° of shoulder abduction. Symptoms increased with the addition of contralateral cervical spine sidebending and decreased with the addition of ipsilateral cervical spine sidebending. Symptoms were also noted to increase with the addition of wrist and finger extension at the point of symptom reproduction with shoulder abduction. This was performed to examine the response of the proximal symptoms to movement of a more distal joint. A ULTT of the left upper extremity resulted in a reported painless pulling sensation in the ventral forearm, with elbow extension to 80° short of full elbow extension.
Joint Segmental Mobility Segmental mobility testing of the cervical and upper thoracic spine (C2-T6) was examined as described by Maitland. Jull et al. found physical examination by a skilled manual therapist to be as accurate as radiologically controlled diagnostic blocks in detecting symptomatic joints in the upper cervical spine. Recent evidence suggests that posterior-to-anterior mobilization at the C5 level produces movement in the entire cervical spine, suggesting that mobilization is not segment specific. Despite limited evidence supporting the reliability and validity of cervical spine segmental mobility testing, examination was carried out based on evidence indicating the benefits of mobilization techniques in the presence of upper quarter joint mobility impairments associated with shoulder pain and disability. Increased resistance was noted with posterior-to-anterior pressures over the right C5-6 segment. The patient reported local pain with pressures at this segment. These pressures did not, however, reproduce the patient’s pain (P1 or P2).

**Diagnosis and Prognosis**

Based on an evaluation of the initial examination data, it was hypothesized that impairments of cervical spine segmental mobility and increased neural tissue mechanosensitivity may have been contributing to the patient’s symptoms. The initial onset of symptoms suggested a possible neural traction mechanism of injury, and impairments noted with upper limb tension testing support the hypothesis of increased neural tissue mechanosensitivity. Although the patient’s symptoms were not reproduced with segmental mobility testing of the cervical spine, several studies have described the relationship between impaired segmental mobility of the cervical spine and increased neural tissue mechanosensitivity. The impairments noted with shoulder ROM testing can also reasonably be attributed to increased neural tissue mechanosensitivity. The lack of response to subacromial injection provided an indication that the shoulder was not the source of symptoms.

Given the patient’s good general health, the lack of prior episodes of symptoms, and the short duration of symptoms, prognosis was believed to be good. Prognosis could not be reliably supported by the available literature due to the lack of consistent diagnostic criteria used in prognostic studies.

**Intervention**

The patient was seen in physical therapy once a week over the course of 5 weeks.
The patient was educated regarding the physical therapy diagnosis and the intended intervention approach, and specific functional goals were discussed. Intervention consisted of patient education and mobilization of the impaired cervical spine segment. The decision to proceed with this intervention approach was based on the hypothesis of impaired cervical spine segmental mobility and increased neural tissue mechanosensitivity contributing to the patient’s symptoms. Studies examining the role of manual therapy for shoulder pain, including treatment of cervical spine impairments, have demonstrated positive results.\textsuperscript{3,4,22,35,43} The benefit of cervical spine mobilization for patients with evidence of increased neural tissue mechanosensitivity has also been reported.\textsuperscript{1,11-13} In my clinical experience, interventions directed at impaired spinal segmental mobility can be particularly beneficial when the ability to directly address mobility of the upper extremity is limited due to excessive pain and guarding. A specific manual therapy technique was applied solely to the impaired cervical spine segment in an effort to better evaluate the contribution of this impairment to the patient’s symptoms.

Each physical therapy session consisted of obtaining relevant subjective information, completion of the SPADI questionnaire, examination of key impairments, treatment, and posttreatment re-examination. The mobilization techniques were performed and graded as described by Maitland.\textsuperscript{32}

Session 1 (Day 1) The first intervention immediately followed the initial examination. Grade III+ posterior-to-anterior mobilization of the right C5-6 segment was performed for 3 bouts of 30 seconds (Figure 3). Following the mobilization, AROM of right shoulder flexion was re-examined in standing and was found to have improved from 50° to 75°, with decreased pain noted by the patient. The patient was then positioned in supine, and PROM of the shoulder was re-examined. Although minimal change in shoulder PROM was noted, decreased guarding was noted with testing. The patient was instructed to monitor her symptoms until the next physical therapy session.

Session 2 (Day 8) At the second physical therapy session, the patient reported an overall improvement of 50% in her pain and functional ability since the initial session. She reported that the day of the initial session was her “best day” since the onset of symptoms. The patient reported resolution of her scapular region pain, but continued to experience anterior right shoulder pain with activities involving reaching overhead. Her SPADI score was now 68%, compared to 83% at the initial session.

The patient demonstrated 80° of right shoulder AROM flexion, with end-of-range pain (P1) noted. Re-examination of muscle strength testing now revealed painless maximal isometric contraction of right shoulder abduction and external rotation. In supine, the ULTT reproduced the patient’s pain at 60° of shoulder abduction. Pain was accompanied with a muscle guarding end feel. In this position, symptoms were lessened with ipsilateral cervical spine sidebending. Increased resistance was again noted at the right C5-6 segment, but was now present only with end-of-range and medially directed posterior-to-anterior pressures. Minimal local pain was noted with palpation.

Grade IV++ mobilization of the right C5-6 segment was performed for 3 bouts of 30 seconds with medially directed posterior-to-anterior pressures.

The patient demonstrated 125° of active right shoulder flexion immediately following the joint mobilization. A ULTT was performed to 20° of shoulder external rotation prior to the onset of symptoms. Both tests were limited by reproduction of P1 at the end of range.

Session 3 (Day 15) The patient reported continued improvement, specifically noting decreased pain and difficulty with washing and brushing her hair. Reaching for something on a high shelf still produced right anterior shoulder pain. Her SPADI score was now 22%.

The patient was now able to demonstrate AROM of shoulder flexion to 118° with mild end-of-range pain. A ULTT to 90° of shoulder abduction reproduced P1. The pain was again relieved by ipsilateral cervical spine sidebending. Increased resistance was again noted at the right C5-6 segment, but was now present only with end-of-range and medially directed posterior-to-anterior pressures.

The patient demonstrated 125° of active right shoulder flexion immediately following the joint mobilization. A ULTT was performed to 20° of shoulder external rotation prior to the onset of symptoms. Both tests were limited by reproduction of P1 at the end of range.

Intervention was again directed at the right C5-6 segment. Based on the patient’s positive response to the first intervention, mobilization was performed further into resistance (grade IV++) for 3 bouts of 30 seconds.

On re-examination, 90° of active right shoulder flexion was measured and the ULTT revealed reproduction of symptoms at 75° of shoulder abduction. These tests were again limited by end-of-range pain (P1) and muscle guarding, although the intensity of symptoms was subjectively less.

Session 4 (Day 22) The patient reported almost complete return to normal functional ability. Minimal pain was present with overhead activity. She had not yet resumed her weightlifting exercise routine. Her SPADI score was 16%.

AROM shoulder flexion was measured at 130°. In supine, passive shoulder motion of the shoulder was examined utilizing the locking and quadrant positions described by Maitland.\textsuperscript{31} Testing revealed minimal P1 reproduction and stiffness at the peak of the quadrant position. A ULTT was performed to 90° lateral rota-
tion with reproduction of P1. Mild end-of-range stiffness was noted with medially directed posterior-to-anterior pressure at the right C5-6 segment. Mobilization of the right C5-6 segment was performed as described in session 3.

Upon re-examination, the patient demonstrated painless AROM of shoulder flexion to 155°, which was then cleared with passive overpressure. Passive shoulder quadrant testing was symmetric and painless. A ULITT was performed to 70° of elbow flexion with production of painless stretching in the anterior shoulder region. The patient was also able to demonstrate her weightlifting exercises without pain. The patient was instructed to resume all regular activity, including her usual exercise routine. She was instructed to monitor any symptoms associated with return to activity.

**Session 5 (Day 29)** The patient reported full return to normal function and almost complete resolution of her pain. She noted only very mild, occasional symptoms with reaching and lifting overhead. Her SPADI score was 1.5%.

AROM shoulder flexion was demonstrated to 155°. With overpressure, the patient reported minimal stiffness, but no reproduction of P1. Passive shoulder quadrant testing was minimally stiff and painless. A ULITT performed to 70° of elbow flexion produced mild, painless stretching of the right anterior shoulder region. Examination of the right C5-6 segment revealed normal and painless mobility.

The patient was discharged from physical therapy as she met her goals. She was encouraged to continue her usual exercise routine and follow up if any exacerbation of symptoms was experienced.

**6-Month Follow-up** The patient was contacted by telephone 6 months status post-discharge. She reported a full return to her usual activities, without exacerbation of symptoms. The SPADI was administered by telephone and scored 0%.

### OUTCOMES

The patient’s SPADI score improved from 83% to 1.5% over the course of 5 weekly physical therapy sessions. Improvements in the SPADI are depicted in **Figure 4**. The patient reported full return to usual activity, with only mild, occasional symptoms associated with lifting and reaching overhead. A 6-month follow-up telephone call revealed complete resolution of symptoms with a SPADI score of 0%.

On physical examination, improvement was noted in all of the impairments noted at the time of the initial examination. **Figure 5** illustrates the improvement in AROM of shoulder flexion over the course of interventions.

### DISCUSSION

The purpose of this case report was to describe a manual physical therapy management strategy for a patient with shoulder pain and disability, specifically addressing impairments of the cervical spine and upper limb neural tissue believed to contribute to the patient’s symptoms. The positive results described in this case suggest that addressing all potentially contributing upper quarter sources, including the cervical spine and upper limb neural tissue, may lead to improved outcomes in this patient population.

The positive outcomes reported in this case are consistent with studies examining the benefit of manual therapy interventions for shoulder pain. Bang and Deyle demonstrated that manual therapy combined with exercise is better than exercise alone for improving outcomes in patients with shoulder impingement syndrome. In patients with shoulder pain diagnosed as originating from the shoulder girdle, Bergman and Winters demonstrated that manual therapy is an effective intervention.

In patients diagnosed with cervicobrachial pain syndrome, positive outcomes associated with manual therapy intervention have been described. However, these interventions have not been studied in a patient population with isolated shoulder pain and disability. The role of increased neural tissue mechanosensitivity contributing to isolated shoulder pain also remains to be studied.

In this case, it was hypothesized that impairments of segmental mobility at the right C5-6 segment, along with increased mechanosensitivity of associated neural tissue, were contributing to the patient’s complaint of shoulder pain and disability. Various mechanisms have been proposed to explain how impaired cervical spine segmental motion may affect neural tissue and result in pain and functional limitation of the shoulder. Coppieters hypothesized that minor nerve irritation caused by impaired segmental motion may affect mechanical and physiological properties of the nerve, resulting in increased mechanosensitivity of the neural tissue. It was further suggested that limited shoulder mobility may be related to a nociceptively mediated muscle response. This hypothesis is based on the study by

![Figure 4](image1.png)  
*Figure 4. Shoulder pain and disability score at each visit. Session 1 corresponds to the initial visit. Zero percent corresponds to no pain or disability and 100% is maximum pain and disability.*

![Figure 5](image2.png)  
*Figure 5. Shoulder flexion active range of motion preintervention and postintervention for each physical therapy session.*
Coppieters et al.,\(^{13}\) demonstrating altered force generation of shoulder-girdle elevation during upper limb tension testing in patients with neurogenic pain disorders.

Several hypotheses have also been devised to explain the ability of manual therapy intervention to reduce pain resulting from impaired joint mobility and increased neural tissue mechanosensitivity. Theories include the blocking of afferent pain signals through mechano-receptor stimulation, the reduction of mechanical forces on neural tissue by restoring normal segmental motion, and the activation of descending pain inhibition systems.\(^ {4,12,29}\)

Based on the limitations of the case report format, no conclusions can be made regarding effectiveness of the management strategy described. Arguments can be made that the outcomes were related to the natural course of the disorder, the subacromial injection, or placebo effect. However, based on the conclusions of Ginn et al.,\(^{28}\) shoulder pain and function cannot be expected to improve spontaneously within 1 month. In regard to the subacromial injection, a more immediate response (30 minutes) would be expected, as this is considered the reference standard test for subacromial impingement syndrome.\(^{7}\) In this case, the patient experienced no relief immediately following the injection, with symptoms remaining unchanged until following the first physical therapy session 1 week later.

Further research elucidating the influence of all upper quarter sources in patients with shoulder pain and disability may lead to the development of improved physical therapy management strategies. In this case, positive functional outcomes are described in a patient with isolated shoulder pain and disability treated with a specific manual therapy technique directed at a specific segment in the cervical spine. I believe future research should investigate the benefit of manual therapy interventions directed at specific structures to better understand the relative influence of various upper quarter impairments on shoulder pain and disability.

**Acknowledgements**

The author would like to acknowledge the faculty of the Kaiser Permanente Los Angeles Orthopaedic Manual Therapy Fellowship Program for their assistance in reviewing this report.

**References**


Shoulder Pain and Disability Index

Please place a mark on the line that best represents your experience during the last week attributable to your shoulder problem.

How scale

How severe is your pain?

Circle the number that best describes your pain where: 0 = no pain and 10 = the worst pain imaginable.

<table>
<thead>
<tr>
<th>At its worst?</th>
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<tbody>
<tr>
<td>When lying on the involved side?</td>
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<tr>
<td>Reaching for something on a high shelf?</td>
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<tr>
<td>Touching the back of your neck?</td>
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<td>Pushing with the involved arm?</td>
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Total pain score ______ / 50 x 100 = ______ %
(Note: If a person does not answer all questions divide by the total possible score, eg if 1 question missed divide by 40)

Disability scale

How much difficulty do you have?

Circle the number that best describes your experience where: 0 = no difficulty and 10 = so difficult it requires help.

<table>
<thead>
<tr>
<th>Washing your hair?</th>
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<tr>
<td>Washing your back?</td>
<td>0</td>
<td>1</td>
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<td>Putting on an undershirt or jumper?</td>
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<td>Putting on a shirt that buttons down the front?</td>
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<tr>
<td>Putting on your pants?</td>
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<td>Placing an object on a high shelf?</td>
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<td>Carrying a heavy object of 10 pounds (4.5 kilograms)</td>
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<td>10</td>
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<tr>
<td>Removing something from your back pocket?</td>
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<td>1</td>
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Total disability score: ______ / 80 x 100 = ______ %
(Note: If a person does not answer all questions divide by the total possible score, eg if 1 question missed divide by 70)

Total Spadi score: ______ 130 x 100 = ______ %
(Note: If a person does not answer all questions divide by the total possible score, eg if 1 question missed divide by 120)

Minimum Detectable Change (90% confidence) = 13 points
Change less than this may be attributable to measurement error