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Original article

The Shoulder Pain and Disability Index: Is it sensitive and responsive to immediate change?

Sean P. Riley [a, b, *], Mark P. Cote [a], Brian Swanson [c], Vincent Tafuto [a, b], Phillip S. Sizer [d], Jean-Michel Brismée [d]

[a] UCONN Health, Farmington, CT, USA
[b] University of Connecticut Physical Therapy Program, Storrs, CT, USA
[c] Texas Woman's University, Houston, TX, USA
[d] Center for Rehabilitation Research, School of Allied Health Sciences, Texas Tech University Health Sciences Center, Lubbock, TX, USA

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ABSTRACT

Background: The Shoulder Pain and Disability Index (SPADI) is designed to detect changes in shoulder pain and disability after a one-week interval. With the new Medicare guideline, the SPADI may have to be employed for time frames of less than one week.
Purpose: To determine if the SPADI or its subscales could detect immediate changes in pain and function after a thoracic manipulative intervention known to produce short-term improvement and by comparing it to changes on the numeric pain rating scale (NPRS).
Methods: Subjects with primary complaints of non-post-surgical shoulder pain completed the NPRS and the SPADI prior to and immediately following interventions.
Findings: The SPADI pain subscale detected statistically significant differences that were also detected using the NPRS. In addition, the SPADI pain score and the NPRS scores were moderately correlated between the pre-intervention SPADI and NPRS scores ($r = 0.49–0.61$, $p < 0.001$) and post-intervention SPADI and NPRS scores ($r = 0.49–0.67$, $p < 0.001$). These differences did not appear to be sensitive or responsive to immediate change.
Clinical relevance: Since the SPADI may have to be employed in durations of less than one week secondary to third party payer requirements, it is valuable to validate the SPADI for this particular use.
Conclusion: Although SPADI scores demonstrated low sensitivity and responsiveness to immediate changes, the SPADI pain scale was able to detect changes in durations of less than one week. This finding should be confirmed through further prospective experimentation.

1. Introduction

The Shoulder Pain and Disability Index (SPADI) is an outcome tool that is widely used to measure shoulder pain and disability in patients with shoulder symptoms. The SPADI has been shown to be a valid measure of shoulder specific disability (Roach et al., 1991; Heald et al., 1997; Paul et al., 2004; MacDermid et al., 2006; Roy et al., 2009). The validity of the SPADI has been demonstrated in patients with specific shoulder disorders including osteoarthritis and rheumatoid arthritis, (Christie et al., 2011) adhesive capsulitis, (Tveita et al., 2008; Staples et al., 2010) joint replacement surgery, (Angst et al., 2007) rotator cuff disease, (Ekeberg et al., 2008) and shoulder impingement (Engebretsen et al., 2010). Moreover, the SPADI has been shown to be valid when used in large populations (Hill et al., 2011).

The capability of a patient derived outcome score such as the SPADI to provide a valid measure of shoulder pain and disability depends in part on its responsiveness. The minimal clinically important difference (MCID) and the minimal detectable change (MDC) are often used as measures of responsiveness for an outcome tool. The MCID of the SPADI is 8 (Paul et al., 2004) and the MDC (95% CI) is 18 (Schmitt and Di Fabio, 2004; Angst et al., 2008). These measures suggest that a change of 8 may be the smallest detectable change in the patients' scores, whereas a change in score of up to 18 may reflect the extent of measurement error occurring

* Corresponding author. MARB 1st Floor, 263 Farmington, CT 06030, USA. Tel.: +1 860 679 3233.
E-mail address: sriley@uchc.edu (S.P. Riley).

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with repeated administration of the SPADI. It is important to consider that the MCID and MDC will vary depending on sample size, population and methodology used for calculation (Copay et al., 2007; Huang et al., 2011; Wang et al., 2011; Wright et al., 2012; Quinn et al., 2013).

An outcome tool's responsiveness may vary depending upon the time interval between administrations. The SPADI is structured in a manner in which the respondent is asked to rate their experience over the previous week. Specifically, the directions for the SPADI read, "Please place a mark on the line that best represents your experience during the last week attributable to your shoulder problem." The SPADI is therefore designed to capture change over a one-week time frame. While the SPADI does not appear to be an appropriate measure of change in time periods of less than one week, it has been routinely used during such a shortened time-frame in both clinical research and practice (Thelen et al., 2008; Boyles et al., 2009; Mintken et al., 2010; Bezerra et al., 2012). Because of the disparity between SPADI's intent and practice, the purposes of this present study were: (1) to determine if there was a difference in the SPADI score from pre-intervention to immediate post-intervention on the same day; (2) to compare the SPADI scores to the numeric pain rating scale (NPRS); and (3) to determine if the SPADI was sensitive to change and responsive within our sample from pre-test to immediate post-test.

2. Methods

This study is a planned secondary analysis of a previously published randomized clinical trial that explored whether messaging (positive or neutral) or high-velocity low amplitude thrust manipulations (HVLATMs) (thoracic versus scapular sham thrust) had any effect on patients suffering from musculoskeletal shoulder pain. The manipulative techniques were provided to each subject in the prone position through either the thoracic spine or scapula based on randomization. The methods of this trial have been previously described. This study protocol was approved by the local Institutional Review Board and was registered with ClinicalTrials.gov.

2.1. Participants

Patients seeking care for non-post-surgical shoulder pain were recruited from a local University Department of Outpatient Rehabilitation using systematic consecutive sampling. Table 1 contains the inclusion and exclusion criteria for the study participants.

Table 1
Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
• Patients between 18 and 69 years of age • Shoulder pain ≥2/10 ≤ 8/10 at time of testing • Active range of motion above the horizontal • Ability to lie prone with arms at side • At least one of the following: 1 Positive Hawkins–Kennedy Sign 2 Positive Neer Impingement Sign 3 Painful resisted abduction 4 Painful resisted external rotation at 0°of abduction with the elbows bent to 90°	• Contraindications to spinal manipulation • Primary complaints of neck or thoracic pain • Positive cervical distraction or Spurling's test • A large three-dimensional limitation of arm motion of greater than 20° with any passive motion of the shoulder, as compared to the contralateral side • Previous history of shoulder surgery • Physical therapy or chiropractic treatment to the shoulder or thoracic spine within the three months • Injection into the shoulder joint within 30 days • Current pregnancy • Inability to attend a short-term follow-up

2.2. Procedures

Participants were randomly assigned to receive an HVLATM directed at either the thoracic spine or scapula, and to receive either a positive or neutral instructional set.

2.3. Clinical outcomes

The SPADI was used as the primary clinical outcome measure. The NPRS was used to capture 5 different pain rating measures: (1) average pain in the previous 24 h; (2) present pain at rest; (3) shoulder pain with elevation above shoulder level; (4) pain with the Hawkins–Kennedy test (average of 3 trials), and (5) pain with the Neer test (average of 3 trials). The NPRS was anchored with zero being equivalent to no pain and 10 representing the worst pain imaginable. The test retest reliability of the NPRS ranges from 0.67 to 0.96 (Jensen et al., 1986; Ferraz et al., 1990; Jensen et al., 1999; Stratford and Spadoni, 2001). The MDC for the NPRS applied to the upper extremity has been reported as 3 (Stratford and Spadoni, 2001). All outcome measures were collected by a blinded examiner prior to and immediately following treatment interventions.

2.4. Statistical analyses

Descriptive statistics (means, standard deviations, frequency counts, minimum and maximum values) were carried out using Excel Version 2010 (Microsoft Corporation) for the subjects' characteristics including age, gender, and symptom duration, as well as SPADI and NPRS measures. Inferential statistics were used to analyse differences in outcome measures from pre-to immediate post-test. The Shapiro–Wilk test was used to determine if the data were normally distributed ($p > 0.05$). The Levene's test was used to assess for homogeneity of variance ($p > 0.05$). The data were normally distributed and were therefore analysed using parametric statistics.

The paired t-test was used to determine if there was a statistically significant difference between the SPADI pain, disability scores, total scores, and NPRS scores prior to versus immediately following the interventions. The Pearson correlation coefficient was used to determine if there was a relationship between the SPADI (pain, disability, and total scores) and the NPRS (average pain last 24 h, present pain, above shoulder pain, pain with Hawkins–Kennedy test, pain with Neer test).

Sensitivity to change and responsiveness were determined following the rationale and methodology of Pardasaney et al. (2012). The authors defined *sensitivity to change* as an instrument's capability to detect change regardless of whether it's clinically meaningful and *responsiveness* as an instrument's ability to measure change is clinically relevant or meaningful. Their assumption was that change would be homogeneous throughout the entire sample. In response, distribution-based statistics (Cohen's d effect size, standardized response mean, and paired *t* tests) was appropriate (Stratford and Riddle, 2005).

We did not include a secondary shoulder outcome measure in the original study so anchor based methods for determining sensitivity to change was not feasible. We therefore used Cohen's d effect size, standardized response means (SRMs), and paired *t* tests as measures of sensitivity to change with larger effects size and SRMs indicating higher sensitivity and the minimally important difference (MID) as a measure of responsiveness, which has been recommended in these cases (Revicki et al., 2008).

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