Usefulness of Shoulder36 in rotator cuff tears: Comparison with Simple Shoulder Test

Running head: Shoulder36 and Simple Shoulder Test

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Ethical disclosure

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Abstract

Background: In patients with rotator cuff tears, Shoulder36 (Sh36) was compared to the Simple Shoulder Test (SST) to determine a broader use of Sh36 worldwide.

Methods: Sh36, SST, “Constant score, “and the Japanese Orthopaedic Association score (JOA) were used to evaluate 230 patients (male, 116; female, 114) during the first visit, analyzed by staff blinded to the study. Pearson's correlation coefficient was used for the statistical analysis.

Results: “The correlation coefficient between the Constant score and each domain in Sh36 was: r = 0.68 (vs pain, p <0.01); r = 0.69(vs range of motion, p <0.01); r = 0.74 (vs muscle strength, p <0.01); r = 0.62 (vs general health, p <0.01); r = 0.66(vs ability of daily living, p <0.01); r = 0.65 (vs ability for sports, p <0.01).“ The correlation coefficient between the JOA and each domain in Sh36 was: r = 0.76 (vs pain, p <0.01); r = 0.73(vs range of motion, p <0.01); r = 0.78 (vs muscle strength, p <0.01); r = 0.68 (vs general health, p <0.01); r = 0.71(vs ability of daily living, p <0.01); r = 0.70 (vs ability for sports, p <0.01). The correlation coefficient between the SST and each domain in Sh36 was as follows: r = 0.73 (vs Pain, p <0.01); r = 0.70 (vs range of motion, p <0.01); r = 0.75 (vs muscle strength, p <0.01); r = 0.67 (vs general health, p <0.01); r = 0.69 (vs ability of daily living, p <0.01); r = 0.64 (vs ability for sports, p <0.01).

Conclusion: A strong association exists between the SST and each domain in the Sh36, in patients with rotator cuff tears (r = 0.64 – 0.73), suggesting the usefulness of Sh36 for patient-based scoring.

1. Introduction

A rotator cuff tear is a common injury in middle-aged and older adults [1]. Conservative or surgical therapy is selected for the treatment, and clinician-based scoring is used to assess the effectiveness of treatment. Recently, the usefulness of patient-based scoring has been reported in systematic reviews [2,3]. Clinical studies are beginning to use patient-based scoring, and it is now being used as frequently as clinician-based scoring [2].

The Simple Shoulder Test (SST), Disabilities of the Arm, Shoulder and Hand questionnaire (DASH), and Shoulder Pain and Disability Index (SPADI) are used for evaluating patients with a rotator cuff tear, and of these, SST is the test most frequently used worldwide [2–4]. The clinician-based scoring system the Constant score is one of the most frequently used worldwide [2]. The

Japanese Orthopaedic Association (JOA) score is used as a clinician-based scoring system for the assessment rotator cuff tear in Japan [5-8], and no patient-based scoring system had been used to assess these patients until Shoulder 36 (Sh36) was introduced in 2011 by the Japan Shoulder Society [9].

Kikugawa and Okuhira reported a significant association between the Sh36 and JOA score in 67 cases of rotator cuff tears [10], which was confirmed by Hirakawa et al. [11]. These studies have demonstrated the usefulness of Sh36 for assessing rotator cuff tears, although there has been no report of this scoring system in the English literature. Therefore, the purpose of this study was to compare SST (a patient-based scoring system frequently used worldwide) with the Sh36, to determine the usefulness of the Sh36, in the assessment of rotator cuff tears.

1. Materials and Methods

This study was performed after approval by the relevant ethics committees.

2.1. Subjects

Between April 2013 and April 2015 at our institutions, 422 patients were diagnosed as having a rotator cuff tear. Inclusion criteria were (1) A rotator cuff tear identified by magnetic resonance images; (2) Simple Shoulder Test and Shoulder36 and Constant score and JOA assessments completed during the first examination. Exclusion criteria were (1) a fracture around the shoulder joint, bilateral rotator cuff tears, pyogenic/systemic progressive arthritis, osteoarthritis, or infection. Consequently, 230 patients (male, 116; female, 114) were subjects for this study. The mean age at the time of the study was 67.7 + 10.2 years, and the mean involved duration was 13.7 + 16.56 months. The tear was partial for 83, small/medium for 147, and massive for and 83. Diabetes, hypertension, and hyperlipidemia were noted in 25, 49, and 26 patients, respectively.

2.2. Data collection

The Simple Shoulder Test (SST) is a simple, short survey employing 12 “yes” or “no” questions regarding pain and function of the shoulder (Table 1). Each question asks the patient to decide whether the shoulder joint disability affects overall physical ability in performing daily living tasks. There are 2 questions on pain; 4, on range of motion; 3 on muscle strength; 2, on sports motions using the shoulder joint, and 1, on the workplace use of the shoulder [4]. The calculation method is 1 point for each item, and 12 points is a perfect score.

Version 1.3 was used for Sh36 (Table 2). A total of 36 questions are categorized into 6 domains (pain, range of motion, muscle strength, general health, ability of daily living (ADL), and sports ability). For each of the 36 questions, patients are asked to self-interpret their symptoms using a scoring system divided into five levels: I have no difficulties:0; I have minor difficulties: 1; I have some difficulties, but I can manage on my own: 2; I have major difficulties and require help from someone: 0; I cannot do it (at all). The domain score is calculated by taking the average of severity scores (0–4), assigned for each domain. When there are questions left blank or invalid for the assessment, the average domain score will be calculated without these responses. However, if a domain collects less than a half of assigned responses, it will be deemed invalid for the assessment. Thus the average is not taken. Domain scores are calculated by two decimal places, rounded up to the second digit.

The Constant score comprised items related to pain (15 points), activities of daily living (20 points), range of motion (40 points), and muscle strength (25 points), amounting to a full score of 100.

The JOA score is typically used to evaluate the treatment outcome of shoulder conditions. It assesses pain (30 points), function (overall function, 10 points; activities of daily living, 10 points), range of motion (active motion, 30 points), radiographic findings (5 points), and joint stability (15 points), amounting to a full score of 100 points. While many minor changes have been applied, the JOA score is currently the most frequently used scoring system to evaluate patients with a shoulder injury in Japan and is applied mostly for comparing pre- and post-treatment outcomes [8, 12–19].

The Constant score, JOA, SST and Sh36 data were evaluated during the first visit, collected by the medical staff blinded to this study; then the evaluated data was handed over to the clinicians.

2.3. Statistical analysis

Statistical analyses were performed using JMP version 13 (SAS Institute Inc., Cary, North Carolina, USA). The Pearson Product-moment Correlation Coefficient was used to calculate the correlation coefficient in examining the relationships between Sh36 and SST , and Constant score and JOA, and Constant score and SST, and JOA and SST, and Sh36 and Constant score, and Sh36 and JOA. A p value of less than 0.05 was considered statistically significant. Descriptive data were expressed as mean value ± standard deviation.

2. Results

The average Constant score, JOA, and SST scores were 49.64±19.18, 72.52 ± 12.84, and 5.28 ± 3.39 points, respectively. Average scores in the Sh36 for each domain were as follows: 2.88 ± 0.96 points for pain; 2.84 ± 0.96 points for range of motion; 2.46 ± 1.14 points for muscle strength; 3.01 ± 0.86 points for general health; 2.87 ± 0.96 points for ability of daily living; and 1.97 ± 1.32 points for ability for sports. The correlation coefficient between the JOA and SST was $r = 0.75$($p < 0.01$). The correlation coefficient between the Constant score and JOA was: $r = 0.85$ ($p < 0.01$). The correlation coefficient between the Constant score and each domain in Sh36 was: $r = 0.68$ (vs pain, $p < 0.01$); $r = 0.69$(vs range of motion, $p < 0.01$); $r = 0.74$ (vs muscle strength, $p < 0.01$); $r = 0.62$ (vs general health, $p < 0.01$); $r = 0.66$(vs ability of daily living, $p < 0.01$); $r = 0.65$ (vs ability for sports, $p < 0.01$). Details are shown in Table 3.

The correlation coefficient between the JOA and each domain in Sh36 was $r = 0.76$ (vs pain, $p < 0.01$); $r = 0.73$(vs range of motion, $p < 0.01$); $r = 0.78$(vs muscle strength, $p < 0.01$); $r = 0.68$ (vs general health, $p < 0.01$); $r = 0.71$(vs ability of daily living, $p < 0.01$); $r = 0.70$(vs ability for sports, $p < 0.01$). Details are shown in Table 3.

The correlation coefficient between SST and each domain in Sh36 was: $r = 0.73$ (vs pain, $p < 0.01$); $r = 0.70$ (vs range of motion, $p < 0.01$); $r = 0.75$ (vs muscle strength, $p < 0.01$); $r = 0.67$ (vs general health, $p < 0.01$); $r = 0.69$ (vs ability of daily living, $p < 0.01$); $r = 0.64$ (vs ability for sports, $p < 0.01$). Details are shown in Table 3.

3. Discussion

There is growing evidence that not only clinician-based but also patient-based scores are frequently used for evaluating patients with rotator cuff tears [2, 20–22]. The patient-based scoring system Sh36 was developed in 2011 and has been used in many Japanese studies [10, 11, 23, 24]. Beneficial characteristics of Sh36 include the following: (1) More than 95% of healthy individuals ranging from 15 to79 years can answer questions in the activities of daily living (ADL) domain; (2) the motion domain is restricted to items related to motion using both upper extremities; (3) this score is gender neutral. Consequently, hand-dominance or gender difference bias on the data obtained from Sh36 is eliminated, offering reliable and valid scoring [9]. Patient-based scoring systems as SST are total assessment score, which are greatly influenced by a single item in these scores; for example, the total score becomes also low when the “pain” score is low. On the other hand, Shoulder 36, not total assessment score, has independent domains (items) and therefore enables relatively detailed evaluation in each item possible. Although Short Forum 36 is a similar evaluation system, Shoulder 36 is a system focusing on shoulder diseases and offering advantages in terms of specificity and availability in the disease.

SST is the most frequently used patient-based score worldwide [2, 25–28]. Godfrey et al. reported a significant association between SST score and American Shoulder and Elbow Surgeons Shoulder Score (ASES) in 251cases of rotator cuff tears [22]. In a systematic review of studies on the patient-based scoring of rotator cuff tears, significant associations among SST, DASH, and SPADI were also demonstrated [2, 3]. The present study analyzed the correlation between SST and Sh36 in patients with rotator cuff tears and found a strong association between these two scores, showing validity and usefulness of the Sh36 as a patient-based scoring system.

The JOA is frequently used in Japan for clinician-based scoring to evaluate the outcome in patients with rotator cuff tears [9]; however, few studies have compared this score with other international scores. Therefore, the present study evaluated the relationship between Constant Score, JOA and SST scores in patients with rotator cuff tears, revealing a significant association between these scoring systems.

The relationship between Sh36 and JOA scores has been evaluated by many research groups in Japan. Ishigaki and Hata [29] examined the relationship between JOA and Sh36 in the early postoperative period of patients who had rotator cuff repair and correlated the JOA score with domains in muscular strength, activity of daily living, and sports activity range of motion. Nakahara et al. [30] evaluated 65 patients who underwent rotator cuff repair using JOA and Sh36 scores. In their study, both scores had significantly improved in the re-tear and non-re-tear groups after surgery; however, the Sh36 score of the re-tear group was significantly lower than in the non-re-tear group, and JOA of the re-tear group was significantly higher than in the non-re-tear group. Therefore, these results consistently indicate the usefulness of the SH36 as a patient-based scoring system. Currently there is no paper which reported Constant Score and Sh36 at the same time because Sh36 is used in Japan.

There are some limitations in this study. First, this is a retrospective study that has a small sample size. Second, the present study exclusively evaluated the patients during their first visit to our

hospital. The data might have been affected if we had evaluated the patients before and after treatment; however, we showed a strong correlation despite this one-point observation. Third, the present study did not examine the correlation with the other patient-based scores. Ohno et al. demonstrated an association between the DASH and each domain in Sh36 in 26 cases of rotator cuff tears before and after surgery [24]. In contrast, Godfrey et al. showed no significant correlation between SST and SF-12. Thus, these facts suggest that data may be affected by the scoring system that is selected for the comparison [15]. Forth, the current study focused on patients with rotator cuff tears, not on the other shoulder disease. Further validation of Sh36 in other shoulder condition remains to be clarified in future study. The strong point of this study was that the test results of Sh36 were comparable to SST, and the Sh36 can be used as a patient-based scoring system worldwide.

The present study examined the relationship between Sh36 and SST scores in patients with rotator cuff tears, to confirm the validity of Sh36 as a patient-based score in these patients. In conclusion, we showed a strong association between the SST and each domain in Sh36 in patients with rotator cuff tears ($r = 0.64 – 0.73$), suggesting the usefulness of Sh36 as a patient-based scoring system in these patients.

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Table 1. Simple Shoulder Test

Question	Answer
Q1. Is your shoulder comfortable with your arm at rest by your side?	Yes / No
Q2. Does your shoulder allow you to sleep comfortably?	Yes / No
Q3. Can you reach the small of your back to tuck in your shirt with your hand?	Yes / No
Q4. Can you place your hand behind your head with the elbow straight out to the side?	Yes / No
Q5. Can you place a coin on a shelf at the level of your shoulder without bending your elbow?	Yes / No
Q6. Can you lift one pound (a full pint container) to the level of your shoulder without bending your elbow?	Yes / No
Q7. Can you lift eight pounds (a full gallon container) to the level of your shoulder without bending your elbow?	Yes / No
Q8. Can you carry twenty pounds at your side with the affected extremity?	Yes / No
Q9. Do you think you can toss a softball under-hand twenty yards with the affected extremity?	Yes / No
Q10. Do you think you can toss a softball over-hand twenty yards with the affected extremity?	Yes / No
Q11. Can you wash the back of your opposite shoulder with the affected extremity?	Yes / No
Q12. Would your shoulder allow you to work full-time at your regular job?	Yes / No

Table 2. Shoulder36

Question	Answer
Q 1. Daily activities at home	(0, 1, 2, 3, 4)
Q 2. Reading a newspaper at a shoulder high	(0, 1, 2, 3, 4)
Q 3. Reaching a back pocket of your trousers using your affected side	(0, 1, 2, 3, 4)
Q 4. Putting your arm through a jacket	(0, 1, 2, 3, 4)
Q 5. Wearing a sweater jacket over your head	(0, 1, 2, 3, 4)
Q 6. Taking off clothes	(0, 1, 2, 3, 4)
Q 7. Placing a jacket on a hanger	(0, 1, 2, 3, 4)
Q 8. Knotting your hands together behind your head	(0, 1, 2, 3, 4)
Q 9. Washing your face with hands	(0, 1, 2, 3, 4)
Q 10. Combing your hair	(0, 1, 2, 3, 4)
Q 11. Washing your armpit opposite to your affected shoulder, using your affected shoulder	(0, 1, 2, 3, 4)
Q 12. Rinsing your whole body by holding a shower head with your affected side	(0, 1, 2, 3, 4)
Q 13. Washing your back with a towel by holding both ends of the towel with an affected side holding the top of the towel	(0, 1, 2, 3, 4)
Q 14. Squeezing out the water from a towel using both hands	(0, 1, 2, 3, 4)
Q 15. Carrying a bowl of soup on the tray	(0, 1, 2, 3, 4)
Q 16. Reaching into a condiment on a table (soy sauce, salt, pepper, etc.) using your affected shoulder	(0, 1, 2, 3, 4)
Q 17. Eating	(0, 1, 2, 3, 4)
Q 18. Tying an apron behind your back	(0, 1, 2, 3, 4)
Q 19. Washing plates with a sponge	(0, 1, 2, 3, 4)
Q 20. Placing plates on a shelf above your head height using the affected shoulder	(0, 1, 2, 3, 4)
Q 21. Holding a filled-up kettle with your affected side	(0, 1, 2, 3, 4)
Q 22. Clapping your hands 10 times	(0, 1, 2, 3, 4)
Q 23. Stretching your body with your hands held up	(0, 1, 2, 3, 4)
Q 24.Sleeping side ways with your affected shoulder lying on the floor	(0, 1, 2, 3, 4)
Q 25.Getting a good sleep	(0, 1, 2, 3, 4)
Q 26.Feeling less fatigue than usual getting through the week	(0, 1, 2, 3, 4)
Q 27.Keeping both your arms horizontal for a minute	(0, 1, 2, 3, 4)
Q 28.Walking with your arms swinging back and forth	(0, 1, 2, 3, 4)
Q 29.Managing daily tasks using your affected shoulder, without help of another shoulder	(0, 1, 2, 3, 4)
Q 30.Wiping windows with your affected shoulder at a head high	(0, 1, 2, 3, 4)
Q 31.Going shopping close to your house	(0, 1, 2, 3, 4)
Q 32.Opening an umbrella (with exception to Push-Button umbrella) with your affected shoulder	(0, 1, 2, 3, 4)
Q 33.Getting on a bus or train	(0, 1, 2, 3, 4)
Q 34.Holding on a strap in a bus or train with your affected shoulder	(0, 1, 2, 3, 4)
Q 35.Moving your shoulders at a recreational level of activities	(0, 1, 2, 3, 4)
Q 36.Moving your shoulders at a competitive level of activities	(0, 1, 2, 3, 4)

Instrument	SST		JOA		CS	
	correlation coefficient	P value	correlation coefficient	P value	correlation coefficient	P value
JOA	0.75	<.01	-	-	0.85	<.01
SST	-	-	0.75	<.01	0.70	<.01
Sh36-Pain	0.73	<.01	0.76	<.01	0.48	<.01
Sh36-Range of motion	0.70	<.01	0.73	<.01	0.57	<.01
Sh36-Muscle strength	0.75	<.01	0.78	<.01	0.55	<.01
Sh36-General health	0.67	<.01	0.68	<.01	0.50	<.01
Sh36-Ability of daily living	0.69	<.01	0.70	<.01	0.60	<.01
Sh36-Ability for sports	0.64	<.01	0.75	<.01	0.70	<.01

SST: Simple Shoulder Test, JOA: Japanese Orthopaedic Association score, Sh36: Shoulder 36,CS:Constatn Score