A Patient-derived Constant-Murley Score is Comparable to a Clinician-derived Score

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Abstract

Background Although there are many advantages to patient-based assessment for musculoskeletal conditions, one common problem is that many of these assessments are perceived to be subjective. To overcome this limitation for patient-based shoulder evaluation, we developed a modified Constant-Murley score that allows patients to complete subjective and objective sections of the score.

Questions/purposes The purpose of our study was to assess the reliability of the new patient-based Constant-Murley score questionnaire by comparing composite scores and subscores obtained with those obtained using the standard physician-based Constant-Murley questionnaire in the same group of patients.

Methods Between August and October 2000, all patients having shoulder surgery in our institute were invited to participate in this study; 58 of 61 (95%) opted to do so and completed the patient-based questionnaire at preoperative and postoperative assessments. The clinician-based Constant-Murley score was performed by a clinician who was blinded to the corresponding patient-based questionnaire. Patients underwent various procedures ranging from manipulation under anesthesia and arthroscopic procedures to reverse shoulder arthroplasty.

Results The mean patient-based and the clinician-based Constant-Murley scores were 47 (SD = 19.5; range, 4–90; N = 108) and 48 (SD = 19.9; range, 4–90; N = 108) points respectively. The mean difference was −1.3 (SD = 3; range, −11 to 8; N = 108) points. The new patient-based Constant-Murley score questionnaire reproduced the patient-based method and had substantial to almost perfect agreement with it for the composite score and various subgroups.

Conclusions These results suggest that a patient-based questionnaire can be used interchangeably with or in place of a clinician-based Constant-Murley score. These results apply to subjective and objective items of the Constant-Murley score.

Level of Evidence Level III, diagnostic study. See the Instructions for Authors for a complete description of levels of evidence.

Each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request. This study was performed at the Reading Shoulder Unit, Royal Berkshire Hospital, Reading, UK.

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Introduction

Shoulder pain is a common problem that can pose difficult diagnostic and therapeutic challenges [1, 7, 8, 24], and it accounts for 5% of all general practitioner musculoskeletal consultations [22, 23]. There are various validated scores for assessment of the shoulder; these scores often require

objective measurements performed by the clinicians and can be time consuming [6, 9, 12, 16, 18, 19]. The Constant-Murley score [12] was introduced to determine functional outcome after treatment of a shoulder injury. It is sensitive, reproducible, and provides good interobserver and intra-observer reliabilities [2, 3, 5, 9–12, 15, 17, 20, 25].

However, clinician input is required to complete an objective assessment of the range of movement and power parts of the score, sometimes resulting in challenges related to followup and resources on research teams. The advantages of patient-based methods of assessment in musculoskeletal conditions have been well established [14, 21]. However, most patient-based questionnaires are perceived to be subjective and lack the important objective outcome measurements [13, 21].

We therefore sought to assess the reliability of the new patient-based Constant-Murley score questionnaire by comparing composite scores and subscores obtained with those obtained using the standard clinician-based Constant-Murley questionnaire in the same group of patients.

Patients and Methods

The Study

Participants in this study were recruited from patients who visited our outpatient clinic between August and October 2000. All patients having shoulder surgery at the Reading Shoulder Unit were invited to participate in this study. Participation was voluntary and no compensation was offered. Each participant was asked to complete the patient-based Constant-Murley questionnaire preoperatively and again 3 months postoperatively. Fifty-eight successive consenting patients (31 women and 27 men) were enrolled in this study. The patients had a mean age of 54 years (range, 19–87 years) (Table 1); 17 (29%) were 65 years or older. They had varied conditions such as impingement syndrome, acromioclavicular joint arthritis, osteoarthritis, frozen shoulder, and calcific deposits, and underwent varied operations including arthroscopic subacromial decompression, arthroscopic acromioclavicular joint excision arthroplasty, manipulation under anesthesia for release of frozen shoulder

contracture, arthroscopic removal of calcific deposits, and rotator cuff repair. Fifty patients (86%) completed additional patient-based and clinician based Constant-Murley score questionnaires at their routine 3-month postoperative followup. The clinician-based questionnaire was completed by a clinician (SM) after the patients had independently completed their corresponding patient-based questionnaire. The clinician was blinded to the corresponding patient-based questionnaire. Altogether, 108 Constant-Murley score assessments were contributed by the 58 patients (58 preoperatively and 50 postoperatively).

Patient-based Constant-Murley Questionnaire

The Constant-Murley score is divided into four subscales, including pain (15 points maximum), activities of daily living (20 points maximum), ROM (40 points maximum), and strength (25 points maximum). The higher the score, the higher the quality of function (minimum 0, maximum 100). The patient-based questionnaire (Appendix 1) was adapted by developing a picture-based range of movement section showing a person with her arm in various positions. The patients were asked to assess the ROM they can perform with their arm, trying to mimic the movements shown in the photographs in the questionnaire while facing a mirror. The power assessment was substituted with household weights such as a kilogram bag of sugar or containers of milk filled with water placed in a carrier bag. The position of the arm at 90° in the scapulothoracic plane is shown in the photographs (Appendix 1, Question F). The patients were asked to note the maximum weight they could hold in this position for 3 seconds. They were instructed to enter a value of zero if they could not achieve the starting position and could not perform the task. Pain assessment was done using a 4-point categorical scale and a 0 to 15 VAS.

The questionnaire used also included several other questions including a VAS question regarding the patient's satisfaction with his or her shoulder (Appendix 1, Question B5) as a simple shoulder value between 0 and 10, several questions relating to preoperative and postoperative work and sporting activities (Appendix 1, Questions C and D), and postoperative satisfaction (Appendix 1, Question D1). These were analyzed separately and were not included in this study.

Table 1. Patient demographics

Sex	Number	Age (years)			
		Mean	SD	Median	Range
Female	31 (53%)	53	15.0	50	19–87
Male	27 (47%)	55	12.0	59	30–71
All	58 (100%)	54	13.5	55	19–87

Sample-Size Calculation

Statistical Methods

Agreement between the patient-based and clinician-based scores was assessed using the Bland-Altman

method [4] and the weighted kappa statistic (Kw) [20]. The Bland-Altman analysis was done for the full Constant-Murley score (continuous scale of 0–100 points), and separately for its power (0–25 points) and pain (0–15 points) components. The pain score used in this analysis was the average of pain recorded by the 4-point (0, 5, 10, 15) scale (Appendix 1, Question A1), and the 0 to 15 points continuous VAS (Appendix 1, Question A2). The Kw statistic was used to assess agreement on each of nine categorical Constant-Murley score components, including five subjective components (pain, limitation in daily living activities, limitation in leisure activities, quality of sleep, level of painless movement) and four objective components (forward flexion, abduction, external rotation, internal rotation). Kw values of less than 0.0, 0.0 to 0.20, 0.21 to 0.40, 0.41 to 0.60, 0.61 to 0.80, and 0.81 to 1.00 were interpreted as showing poor, slight, fair, moderate, substantial, and almost perfect agreement, respectively [20]. Statistical analysis was performed using the SAS system, Release 8.2 (SAS Institute Inc, Cary, NC, USA).

Results

The Constant-Murley score ranged from 4 to 90 covering almost the full 0 to 100-point range, thus allowing assessment of the agreement between the two methods across almost the full possible range (Table 2).

The composite scores provided by patients on the patient-based Constant-Murley questionnaire were nearly identical to those obtained by clinicians for the same patients using the clinician-based Constant-Murley questionnaire (Fig. 1). The random scatter of points in the Bland-Altman plots [4] (Fig. 2A) suggests that differences between the methods are not related to the magnitude of measurements.

The observed bias, or the mean difference between the patient-based and the clinician-based methods, is -1.3 points, being 1.3% of the full 0 to 100-point scale and the

associated 95% limits of agreement are -7.1 to 4.4 points. Neither of the two methods yields results consistently higher or lower than the other (Fig. 2A).

Random scatter of points in the Bland-Altman plots also were found for power and pain scores (Fig. 2B–C). Further analysis of the agreement on nine components of the Constant-Murley score, five subjective and four objective, using the Kw statistic showed almost perfect agreement in seven of nine components and substantial agreement in two (Table 3).

Overall, with 95% limits of agreement being -7.1 to 4.4 , -1.7 to 1.2 , and -1.3 to 1.0 for the Constant-Murley power, and pain scores respectively, the analysis shows that the two methods consistently yield similar results, therefore suggesting that clinician-based questionnaire can be reproduced

Fig. 1 An identity plot for Constant score ($n = 108$) shows the data points aligned in close proximity to the line of identical measurements, suggesting that clinician-based and patient-based methods assessing the Constant-Murley score yield similar results.

Table 2. Results for the full Constant-Murley score and power and pain components

Score	Observed score (points)				
	Method of assessment	Number of patients	Mean	SD	Range
Full Constant-Murley score (0–100 points)	Clinician-based	108	48	20	4–90
	Patient-based	108	47	19.5	4–90
Power (0–25 points)	Clinician-based	108	5	6	0–22
	Patient-based	108	5	6	0–20
Pain (0–15 points)	Clinician-based	108	6.3	3.5	0–15
	Patient-based	108	6.2	3.5	0–15

Fig. 2A–C The Bland-Altman agreement plots for (A) the Constant-Murley score ($n = 108$), (B) the power score ($n = 108$), and (C) the pain score ($n = 108$) are shown.

Table 3. Agreement analysis using weighted kappa for five subjective and four objective components of the Constant-Murley score

Analysis	Constant-Murley score component	Number of patients	Weighted kappa (and 95% CI for weighted kappa)	Agreement (interpretation of weighted kappa)
Subjective	Pain	108	0.98 (0.94–1.00)	Almost perfect
	Limitation in daily living activities	108	0.91 (0.83–0.98)	Almost perfect
	Limitation in leisure activities	108	0.83 (0.74–0.92)	Almost perfect
	Quality of sleep	108	0.76 (0.67–0.86)	Substantial
	Level of painless movement	108	0.86 (0.80–0.93)	Almost perfect
Objective	Forward flexion	108	0.90 (0.86–0.95)	Almost perfect
	Abduction	108	0.87 (0.82–0.92)	Almost perfect
	External rotation	108	0.88 (0.82–0.93)	Almost perfect
	Internal rotation	108	0.80 (0.73–0.87)	Substantial

by the patient-based questionnaire (Fig. 2). The observed bias or mean difference between the two methods that was observed for each of full Constant-Murley power and pain scores was of a small magnitude and no clinical importance.

Discussion

Although there are many advantages to patient-based assessment for musculoskeletal conditions, one common problem is that many of these assessments are perceived to be subjective. We have developed a modification for the Constant-Murley score to allow the patients to complete the score by themselves. The results of this study clearly show good agreement between the clinician-based and the patient-based Constant-Murley scores.

This study has numerous limitations. First, patients enrolled in the study had varied age and shoulder conditions and underwent various surgical procedures. Although we showed our results for a wide range of preoperative Constant-Murley scores, further studies with a more uniform population might add information. Because our study was performed at one site, this raised the question of generalizability.

We found that the patient-based questionnaire consistently yielded similar results as the clinician-based

questionnaire. The composite questionnaire and its nine subgroups showed almost perfect or substantial agreement. Therefore, overall the two methods can be used interchangeably. Attempts to develop a patient-based questionnaire that includes subjective and objective measurements were made previously. Geschwend et al. developed a visual questionnaire and compared it with the Constant-Murley questionnaire and found good correlation between the scores (Geschwend N, Schwyzer H, Loehr JF. Introduction of a visual questionnaire correlating to the Constant shoulder functional score. 9th Congress of the European Society for Surgery of the Shoulder and the Elbow (ESSSE-SECEC). September 19–21, 1996. Nottingham, UK; page 246 [abstract].). Unfortunately we are not aware of other studies comparing these methods nor studies using this new questionnaire during the last decade. We have compared the widely used and well-investigated Constant-Murley score and modified it to allow a patient-based score.

Our results suggest that a patient-based questionnaire can be used interchangeably or in place of a clinician-based questionnaire for subjective and objective items of the Constant-Murley score. Nevertheless we believe additional studies with larger cohorts of patient and more uniform disorders are required.

Appendix 1

Patient-based Questionnaire

Date:

PATIENT'S NAME: PATIENT NUMBER:

D.O.B.: SIDE: RIGHT /LEFT

We would be grateful if you could take a few minutes to fill in this questionnaire. It is an essential part of our evaluation of the results of our treatment and surgery. It ultimately improves the quality of service we provide to you. **PLEASE COMPLETE THE FORM BY CIRCLING THE MOST APPROPRIATE RESPONSE.**

A. PAIN

A1. Do you have pain in your shoulder during **normal** activities? (**Please circle the most appropriate response**)

1. NO PAIN 2. MILD PAIN 3. MODERATE PAIN 4. SEVERE PAIN

A2. LEVEL OF PAIN

If 0 means no pain and 15 means the worst pain you can have, **please circle the number** which describes your shoulder pain when you are doing **normal** activities:

😊 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 ☹

NONE MILD MODERATE SEVERE UNBEARABLE

B. FUNCTION (please circle the most appropriate response)

B1. Does your shoulder limit your occupation or daily living?

1. NO OR VERY SLIGHTLY 2. MODERATE LIMITATION 3. SEVERE LIMITATION

B2. Are your leisure and recreational activities limited by your shoulder?

1. NO OR VERY SLIGHTLY 2. MODERATE LIMITATION 3. SEVERE LIMITATION

B3. Does your shoulder disturb your night sleep?

1. NO 2. SOMETIMES 3. YES

B4. What level can you use your arm for **reasonable** **painless** movement?

1. WAIST 2. CHEST 3. NECK 4. EAR 5. ABOVE HEAD

B5. On a scale of 0 to 10, where **0** is **not satisfied** and **10** is **very satisfied**, how satisfied are you with your shoulder? (**Circle the correct number**)

☹ 0 1 2 3 4 5 6 7 8 9 10 😊

Appendix 1 continued**C. WHAT IS YOUR OCCUPATION?**C1. How well can you perform your occupation? **(Please circle the most appropriate response)**

1. EASILY 2. WITH LITTLE DIFFICULTY 3. WITH MODERATE DIFFICULTY
4. WITH EXTREME DIFFICULTY 5. NOT AT ALL

C2. What are your two main sporting/leisure activities?

.....

C3. How well can you perform these activities? **(Please circle the most appropriate response)**

1. EASILY 2. WITH LITTLE DIFFICULTY 3. WITH MODERATE DIFFICULTY
4. WITH EXTREME DIFFICULTY 5. NOT AT ALL

=====

D. POSTOPERATIVE QUESTIONS - only complete this section if you have had an operation

[Operation: Date of operation:.....]

D1. How do you feel **now**, following your operation?**(Please circle the most appropriate response)**

1. MUCH BETTER 2. BETTER 3. SAME 4. WORSE

D2. Have you **now** **(Please circle the most appropriate response)**

1. Returned to the same occupation?
2. Returned to the same occupation but with decreased level of activity (due to the shoulder)?
3. Changed occupation due to the shoulder?
4. Stopped working altogether because of your shoulder?

D3. If you have changed occupation, what job do you do now?:

.....

D4. Have you **now** **(Please circle the most appropriate response)**

1. Returned to the same level of activity in the same sport?
2. Returned to a decreased level of activity in the same sport (because of the shoulder)?
3. Changed sports because of the shoulder?
4. Stopped playing sports altogether because of the shoulder?

D5. If you have changed sports, what have you changed to?

.....

Appendix 1 continued**E. Range of Motion**

Copy the movements the model is performing – it may be useful to perform this exercise in front of a mirror.

Starting from left to right in each row

- **Tick the box** (below each photograph) if you are **able to perform the action**
- **Leave the box blank** if you **cannot perform** the action

☐ ☐

Appendix 1 continued**F. Strength**

Look at the two photographs below. Try to hold your arm in this position for 3 seconds each time carrying weights in the plastic bag.

Please use as weights within the plastic bag:

- **Bags of sugar**
- and/or
- **Filled plastic bottles of milk** (may be filled with water)
- and/or
- **Whatever is available for you with known weight**

Please record in the spaces below what was **the maximum weight** in kilograms (or pounds) or litres (or pints) that you **were able to hold in this position for 3 seconds** for each arm.

Seen from the front

seen from above

The maximum weight that I was able to hold in this position for 3 seconds:

Right Arm:	<input type="text"/>	Kilograms/Litres	Left Arm:	<input type="text"/>	Kilograms/Litres
Right Arm:	<input type="text"/>	Pounds/Pints	Left Arm:	<input type="text"/>	Pounds/Pints

G. COMMENTS

The space below is for any further comments you would like to make.

Thank you for filling in this questionnaire.

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