The Specific AC Score (SACS): a new and validated method of assessment of isolated acromioclavicular joint pathology

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\textbf{Background:} Acromioclavicular (AC) joint (ACJ) pathology is a common cause of shoulder dysfunction, and treatment recommendations vary. When the efficacy of treatment is evaluated, the ability to measure outcomes specific to the population is essential. The aim of the current research was to develop and validate a specific ACJ questionnaire.

\textbf{Methods:} Items for the “Specific AC Score” (SACS) were generated through the use of an expert panel, existing questionnaires, and patient feedback. Preliminary data analysis identified redundancy of items resulting in the questionnaire being refined. The final SACS was evaluated in 125 patients requiring surgical intervention of the ACJ. Internal consistency (the Cronbach $\alpha$ and corrected item-total correlation), content validity, criterion validity, responsiveness, and test-retest reliability (intraclass correlation coefficient) were examined and compared with the Shoulder Pain and Disability Index, Oxford Shoulder Score, and American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form. The minimum detectable change score was calculated.

\textbf{Results:} The Cronbach $\alpha$ for the total scale preoperatively and postoperatively was high (preoperatively $= 0.91$, postoperatively $= 0.93$). All 3 domains (Pain, Function, Quality of Life) demonstrated acceptable internal consistency ($\alpha > 0.70$), and the correlation between items in each domain was satisfactory. The responsiveness was excellent (effect size, $-2.32$; standard response mean, $-1.85$) and was higher than the other general shoulder questionnaires. There were no relevant floor or ceiling effects. Reliability was high (intraclass correlation coefficient, 0.89) and the minimum detectable change was 6.5 points.

\textbf{Discussion:} This new ACJ-specific questionnaire has been robustly developed, has good measurement properties, and has excellent responsiveness. The SACS is recommended for measuring outcomes in ACJ patients.

\textbf{Level of Evidence:} Basic Science Study; Development and Validation of Outcome Instrument

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\textbf{Keywords:} Acromion; psychometric properties; shoulder; patient-reported outcome measure; reliability; acromioclavicular joint instability; acromioclavicular joint arthritis; acromioclavicular joint osteolysis

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Isolated acromioclavicular joint (ACJ) pathology is a common cause of shoulder dysfunction, with an incidence of 9.2 per 1000 person-years. Numerous pathologies can affect the ACJ, but 2 commonly encountered in clinical practice are ACJ instability in its various forms and osteolysis or osteoarthritis, or both. The management of grade III ACJ instability is particularly controversial, with some authors recommending conservative management and others advocating surgical intervention. Furthermore, there are a variety of opinions regarding the most appropriate surgical technique and the ideal timing of such interventions.

Several authors have attempted to evaluate these issues by examining the long-term clinical outcomes of their patients presenting with ACJ instability. However, the outcome measures used in each of these reports were a Constant Score, University of California, Los Angeles Shoulder Score, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES), simple shoulder test, and the Disabilities of the Arm, Shoulder and Hand or the 11-item Nottingham Clavicular Score (NCS).

Unique clinical and functional features may exist in ACJ pathology, including cosmetic appearance, pain with pressure directly over the joint, and painful clunking/crepitus in the joint. Many widely used patient-reported shoulder outcome scores do not incorporate any questions relating to these aspects of shoulder joint function and have not been developed or evaluated for use in ACJ pathology. There are 3 condition-specific outcome measures designed for use in ACJ pathology: the Taft score, the ACJ Instability Score (ACJIS), and the Nottingham Clavicular Score (NCS).

The Taft score combines pain, objective strength, range of motion, and radiographs. This tool has not been validated and comes with the inherent issue of reliability and examiner bias that occurs when physical examination scores are combined with patient reporting.

The ACJIS also combines radiographic results with patient-reported measures of pain, activities of daily living, cosmesis, and function and is currently being validated in an ongoing prospective study that is yet to be published.

The NCS was designed for use for the patients with ACJ and sternoclavicular joint injuries and those with clavicular fractures. It has recently been published, and it is a 10-item patient-reported outcome measure (PROM) that shows reasonable internal consistency and better responsiveness in postoperative patients compared with other generalized shoulder scores. The commencement of the development of the current questionnaire preceded publication of the ACJIS and NCS.

Considering the controversies surrounding the management of ACJ issues, we determined that there was a need to develop a reliable, valid, and sensitive specific outcome questionnaire that could be used to measure clinical outcome in this population. The aim of this report is to describe the development and validation of a new method of assessment of ACJ pathology.

Materials and methods
Development of the questionnaire

The “Specific AC Score” (SACS) questionnaire was developed in accordance with the COSMIN (COnsensus-based Standards for the selection of health Measurement INstruments) checklist. The protocol included (1) selection of an item/question pool, (2) item scaling, (3) item reduction, (4) determination of reliability, validity, and responsiveness, (5) questionnaire formatting, (6) response format, and (7) questionnaire testing (Fig. 1).

Population identification

The goal of the instrument was to evaluate patients with shoulder disability as a result of an ACJ impairment. Patients with shoulder disability as a result of a ACJ impairment were identified and recruited for this study. Patients were assessed by 1 of 2 shoulder specialist surgeons and had a primary diagnosis of ACJ instability (acute or chronic), osteoarthritis, or osteolysis of the ACJ. Only patients requiring surgical intervention to the ACJ were included to allow for confirmation of an ACJ diagnosis at surgery. Eight patients were found to have a coexisting pathology of a biceps tendon partial tear, glenohumeral synovitis, small labral tear, or a small rotator cuff tear. However, all patients had pain localized to their ACJ, and ACJ pathology was their primary diagnosis.

Selection of an item/question pool

The item generation component of the questionnaire involved 3 facets: a literature review, a focus group involving shoulder specialists, and individual patient interviews. The literature review identified that there were no published ACJ PROMs that were specific and validated at the commencement of the trial.

Due to the lack of pre-existing ACJ-specific PROMs, a list of items that were included in the generalized shoulder PROMs that the surgeons were currently using (Oxford Shoulder Score [OSS], Shoulder Pain And Disability Index [SPADI], ASES, and the L’Insalata Shoulder Questionnaire) were collated and duplicate items removed. This generated a total of 28 items.

Expert focus group

The focus group comprised 3 shoulder specialist surgeons and 3 physiotherapists (2 shoulder specialists) with extensive experience in treating patients with ACJ pathology. These specialists were asked before the meeting to compile a pool of common complaints and problems perceived to be relevant to ACJ pathologies. The group was also presented with the compiled list of 28 items from the generalized shoulder questionnaires. A further 16 items were generated that were specific to the ACI, and in consultation during the focus group, the list was reduced to 37 items covering 5 domains: Pain (A), Specific AC Joint (B), Functional (C), Sporting & Occupational (D), and Psychological & Satisfaction (E).
Questions that were not considered to be relevant by the focus group were removed. These included using a knife/fork at the same time, getting in and out of the car, and specific dressing questions.

Patients were also asked to complete an overall percentage rating of the status of their shoulder in the final item of the questionnaire. This item is not scored in the scale but allows a comparison between the overall SACS score and the perceived percentage of shoulder function.

Patient interviews
The final component of item generation included the questionnaire being administered to ACJ patients before the operation. In a short interview with a physiotherapist (J.F.), the patients provided feedback on the usability of the questionnaire, the wording of items, and also scaled the relevance of each item on an 11-point numeric scale. This process was continued until no new feedback or suggestions from 5 consecutive patients were received. The interview participants were 14 patients (3 women, 11 men; mean age, 39 years; range, 21-60 years) recruited from Melbourne Orthopaedic Group. A chronic ACJ dislocation was present in 6 patients, acute ACJ dislocation in 1, ACJ osteoarthritis in 5, osteolysis in 1, and 1 was about to have a hook plate removed 6 months after his initial operation for an ACJ dislocation.

The 37 items in the initial version of the SACS were reduced to 30 after the patient interviews (see the Supplementary file). Taking into account feedback from patients that the questionnaire was too long, 7 items rated as least relevant were removed.

Preliminary statistical analysis
After the initial reduction of the questionnaire from 37 items to 30 items, the questionnaire was administered to 48 patients with ACJ.
pathologies and preliminary data analysis of internal consistency undertaken using SPSS 24 software (IBM, Armonk, NY, USA).

Internal consistency

The internal consistency is the extent to which items in a subscale are intercorrelated, thus measuring the same construct.\(^6\) The internal consistency of the SACS was measured with the Cronbach \(\alpha\) and the corrected item-total correlation. A Cronbach \(\alpha\) score above 0.70 was considered acceptable.\(^9\) The corrected item-total correlation calculates the correlation of the individual items with the subscale or scale total omitting that item.\(^10\) As recommended, where items correlated between 0.30 and 0.70, the item was retained.\(^16\) Items with correlations of less than 0.2 were discarded. To reduce redundancy in the subsections, highly correlated items (>0.80) were mostly discarded, depending on the number of questions within the domain and patient feedback in the initial phase about the relevance of the item.

Results of preliminary analysis and item reduction

The Cronbach \(\alpha\) results were high for the total score (\(\alpha = 0.93\)) and each subsection: Pain, \(\alpha = 0.94\); Specific AC Joint, \(\alpha = 0.84\); Functional, \(\alpha = 0.96\); Sporting & Occupational, \(\alpha = 0.87\); and Psychological & Satisfaction, \(\alpha = 0.84\).

Item reduction

Corrected item-total correlation analysis identified redundancy of items within 4 of the 5 domains (Pain, Specific AC Joint, Functional, and Sporting & Occupational). Many of the questions were very highly correlated with other items in the same domain, allowing further item reduction. Two questions were removed from pain (A1, A5), 1 from Specific AC Joint (B2), 5 within Function (C1, C3, C6, C7, C9), and 2 in the Occupational & Sport section (D2, D5). (See the Supplementary file.) Two questions (A4: level of pain with touch or pressure applied to the top of the shoulder, and C8: level of difficulty holding affected arm in front for a prolonged period) remained in the questionnaire despite being highly correlated than other questions in their subgroups because these questions were specifically found to be relevant to patients in the early analysis. This resulted in the questionnaire being reduced to 20 items. The domains were also amended and reduced to 3 domains: Pain (A), Function (B), and Quality of Life (C; Fig. 2).

A further analysis of corrected item-total correlations in the new domains identified a low correlation between items in section B (Function) and the item: “Rate the level of difference in appearance of the bones on the top of your shoulder compared to a normal shoulder,” suggesting that it was not measuring the same concept as other items in this domain. Whether this question should be omitted was discussed because we proposed that it may have been more relevant only to the ACJ dislocations subgroup. However, a review found that the participants diagnosed with osteoarthritis had a higher average score (5.49) than that of the participants diagnosed with instability (4.0) and the total question average (5.01). The question was therefore moved to section C (Quality of Life) because this improved the interitem correlation.

Item scaling, weighting, and scoring

A numeric rating scale with responses from 0 to 10 points was chosen over a visual analog scale or Likert scale because it has been found to be the most responsive\(^32\) and could reduce the administrative burden of calculating the score. All items were given the same weight to ensure each domain could be scored individually as well as providing an overall score. A lower total score reflects a better outcome (fewer symptoms and functional impairments), with the maximum raw total score equaling 200. To calculate the final score, the total raw score is summed, divided by the total possible score (200), and multiplied by 100 to create a percentage. If items are not completed or applicable to the patient, the final sum total is divided by the highest possible score of the items completed and multiplied by 100. For example, if the patient completes only 15 of the 20 items, the summed total score is divided by 150 (the highest potential score) and multiplied by 100. This is particularly important in section B (Function), where items referring to sport and occupation may not be applicable. The final question, C6, is not included in the analysis, but can be used to get an overall perceived percentage change in ACJ status.

Methodologic testing and evaluation of the 20-item SACS

We recruited 125 consecutive patients with a primary diagnosis of ACJ pathology (ACJ instability or osteoarthritis) requiring surgical intervention to evaluate the 20-item SACS. Patients completed the SACS, ASES, SPADI, and OSS questionnaires preoperatively and postoperatively where possible. The internal consistency of the SACS was again measured with the Cronbach \(\alpha\), and the corrected item-total correlation using the same cutoff scores as described in the preliminary analysis.

Test-retest reliability

Test-retest reliability is the extent to which scores for the patients are unchanged for repeated measurements over time.\(^27\) Test-retest reliability was examined using an intraclass correlation coefficient (ICC 1,1) in a subgroup of 39 participants who completed the questionnaire twice, 1 to 2 weeks apart, preoperatively. ICC values of less than 0.4 were interpreted as poor reliability, 0.4 to 0.59 fair reliability, 0.6 to 0.74 good reliability, and greater than 0.75 was interpreted as excellent.\(^13\)

Measurement error

Measurement error is the systematic and random error of a patient’s score that is not attributed to true changes in the construct to be measured.\(^37\) The standard error of measurement (SEM) was calculated to determine reliability stability. This score was calculated using ICC results: \(\text{SEM} = \text{standard deviation first test} \times \sqrt{(1 - \text{ICC})}\). The minimum detectable change (MDC) at the 95% confidence interval (MDC\(_{95\%}\)) score, which is the minimum amount of change in a patient’s score that ensures the change is not the result of systematic or random
measurement error, was then calculated using the SEM: MDC 
\[ 1.96 \times \sqrt{2} \times SEM \].

**Content validity**

Content validity is the degree to which the content of a PROM is an adequate reflection of the construct to be measured.\(^3^7\) Content validity was evaluated by a review of floor and ceiling effects. Floor effects (the lowest possible scores) and ceiling effects (the highest possible score) were determined for the subsections and overall scores.

**Criterion validity**

Criterion validity is the degree to which the scores of a PROM are an adequate reflection of a gold standard.\(^3^7\) The presence of criterion validity is accepted if an instrument correlates well (\(>0.70\)) with a gold standard instrument.\(^3^0\) At the time of testing, there was no established gold standard for ACJ outcome; therefore, a comparison

<table>
<thead>
<tr>
<th><strong>Explanation:</strong></th>
<th>For each question you will be asked to rate either your level of pain or difficulty performing different tasks. The rating scale is designed so that 0 reflects no pain or difficulty while 10 reflects the most severe amount of pain or difficulty.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E. g.</strong></td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td>(No pain) 0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

| **Note:** | 1. Please circle one number only | 2. A rating of 2 would represent minimal levels of pain. |  |

<table>
<thead>
<tr>
<th><strong>A) Pain Section:</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Rate your level of pain in your shoulder when it is at its worst – most severe.</td>
<td></td>
</tr>
<tr>
<td>No pain</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>A2. Rate your level of pain in your shoulder when it is at its best.</td>
<td></td>
</tr>
<tr>
<td>No pain</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>A3. Rate the level of pain when you press/ touch or there is pressure applied to the top of your shoulder. (Eg. Lap top or hand bag strap).</td>
<td></td>
</tr>
<tr>
<td>No pain</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>A4. Rate the level of pain, tension or pulling sensation you feel in your neck and/or affected shoulder blade region.</td>
<td></td>
</tr>
<tr>
<td>No pain</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>B) Function Section:</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B1. Rate the amount of clicking and/or grinding and/or clunking you experience in your shoulder.</td>
<td></td>
</tr>
<tr>
<td>No clicking</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>B2. Indicate if your arm feels the need to be supported when walking (e.g. Resting your arm in a pocket or using a sling).</td>
<td></td>
</tr>
<tr>
<td>No need to support</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>B3. Rate your level of difficulty taking weight or leaning through your arm (e.g. Push up, cycling, yoga).</td>
<td></td>
</tr>
<tr>
<td>No difficulty</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>B4. Rate your level of difficulty carrying heavy objects by your side for greater than 5 minutes (e.g. Bag of shopping).</td>
<td></td>
</tr>
<tr>
<td>No difficulty</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>B5. Rate the level of difficulty reaching across your body with your affected arm (e.g. To reach across and touch the unaffected shoulder)</td>
<td></td>
</tr>
<tr>
<td>No difficulty</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>B6. Rate your level of difficulty pushing heavy objects or weights overhead (e.g. Greater than five kilograms).</td>
<td></td>
</tr>
<tr>
<td>No difficulty</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

**Figure 2** The Specific AC Score (SACS). AC, acromioclavicular.
with generalized PROMs commonly used in this population (SPADI, OSS, and the ASES) was performed. A correlation between the total SACS score and the overall percentage rating of shoulder status by participants (item C6 of the SACS) was also performed. The Pearson product moment correlation coefficient was used to analyze the correlation between the tools, and considering the lack of an established gold standard, it was expected the correlations might only reach 0.60.
Responsiveness

Responsiveness is the ability of a PROM to detect change over time in the construct to be measured. Responsiveness to change was assessed by comparing the preoperative scores with postoperative scores taken between 6 and 24 months postsurgery. Responsiveness was measured by calculating the effect size (ES) and standard response mean (SRM). The ES was calculated using the following formula: \( \frac{\text{mean postsurgical scale} - \text{mean presurgical scale}}{\text{standard deviation of the presurgical scale}} \). The SRM was calculated using the following formula: \( \frac{\text{mean postsurgical scale} - \text{mean presurgical scale}}{\text{standard deviation of the change in scale}} \). The ES and SRM were interpreted as poor, \(< 0.50\); adequate, \(0.50\) to \(0.79\); and excellent, \(> 0.80\).

Results

The study was conducted at Melbourne Orthopaedic Group, Melbourne, Victoria, Australia.

Testing of final version

The final 20-item SACS was administered to 125 patients (93 men and 32 women; mean age, 41 years; standard deviation, 13.8; range, 17-75) preoperatively, and 72 of these patients (54 men and 18 women; mean age, 42 years; standard deviation, 13.6; range, 18-75) were tested again postoperatively. Mean duration between questionnaires administered preoperatively and postoperatively was 13.8 months (range, 5-24 months). Osteoarthritis of the ACJ was diagnosed in 69 participants, acute ACJ dislocations in 31, chronic ACJ dislocations in 20, fibrocartilage tears in 3, and ACJ subluxations in 2. The surgical treatment methods undertaken were as follows:

- Clavicular hook plate and Weaver-Dunn (\(n = 15\))
- Clavicular hook plate, Weaver-Dunn, and rotator cuff repair (\(n = 1\))
- Clavicular hook plate (\(n = 19\))
- Clavicular hook plate and hamstring graft (\(n = 1\))
- Clavicular hook plate and excision of distal ACJ (\(n = 9\))
- Arthroscopic excision of distal ACJ (\(n = 66\))
- Arthroscopic excision of distal ACJ and synovectomy (\(n = 2\))
- Arthroscopic excision of distal ACJ, rotator cuff repair, and bicep tenotomy (\(n = 1\))
- Arthroscopic excision of distal ACJ and bicep tenodesis (\(n = 2\))
- ACJ débridement (\(n = 3\))
- Dogbone reconstruction (\(n = 5\))
- ACJ Surgilig reconstruction (\(n = 1\)).

Internal consistency

Acceptable internal consistency was demonstrated preoperatively and postoperatively for each subsection of the scale and the overall total score (Table S1). The total-item correlations in each domain were satisfactory, with good relevance and no redundancy. Question B1 (amount of clicking and/or grinding and/or clunking) demonstrated low interitem correlations, and removal of this item would improve the \(\alpha\) by 0.011 both preoperatively and postoperatively. Question C1 (appearance of shoulder) had a low interitem correlation, but this was only seen preoperatively.

Test-retest reliability and MDC

A subgroup of 40 patients completed the questionnaire twice preoperatively with 1 to 2 weeks between the first and second questionnaire (mean, 9 days; range, 7-14 days) to establish the test-retest reliability. Reliability was excellent (ICC(1,1) = 0.89) and the calculated MDC95% was 6.5%.

Content validity

Postsurgery, 8 of 72 participants (11%) achieved the lowest possible score on the SACS, representing the absence of symptoms and disability (Table I). No participants recorded the maximum score. These data represent acceptable content validity. In contrast, the SPADI, OSS, and ASES all recorded maximum or minimum scores in more than 30% of the participants postoperatively.

Criterion validity

The preintervention and postintervention SACS was moderately correlated with the OSS and ASES (Table II). High correlations were seen between the SACS and the SPADI.

Responsiveness

The responsiveness of the SACS questionnaire was classified as excellent (ES, \(-2.32\); SRM, \(-1.85\)) and was higher than the SPADI (ES, \(-1.64\); SRM, \(-1.60\)), OSS (ES, 1.29; SRM, 1.09), and the ASES (ES, 1.61; SRM, 1.17).

Discussion

The SACS is a PROM specifically for evaluating patients with ACJ pathology, including instability and arthritis. The scale was robustly designed in line with the COSMIN checklist. The SACS started as a 37-item PROM, and after a 2-tiered reduction, is now 20 items assessing the 3 domains of Pain, Function, and Quality of Life. The development of the SACS took account of the unique clinical and functional features that may exist in ACJ pathology, including cosmetic appearance, localized pain, and clicking/clunking of the joint, features missing in generalized shoulder questionnaires. The development meets the standards for the development of a PROM by including patients in the process by receiving their feedback on the relevance of the questions to their condition. 37,40
The SACS has high overall internal consistency and acceptable individual item correlations in the 3 domains. The test-retest reliability of the scale was high, and the calculated MDC score guides clinicians and researchers on true measures of change when using the scale. The content validity of the scale, as measured by the floor and ceiling effects, was satisfactory. There were no ceiling effects, and minimal floor effects were measured postoperatively, within the acceptable range identified a priori. Comparatively, more than 30% of participants recorded the best possible scores on the other questionnaires postsurgery. This demonstrates that these scales are not sufficient to measure ability in ACJ disorders.

Preliminary evidence of criterion validity was demonstrated by high correlations with the SPADI and moderate correlations with the OSS and ASES. Correlations with the SPADI were higher than expected a priori because the gold standard for measuring outcomes in ACJ pathology is not clear. The validity of the NCS was published during preparation of this report. The NCS is a 10-item PROM designed for patients with clavicular, ACJ, and sternoclavicular joint pathologies. In a sample of 90 patients, the NCS was compared with the Constant Score, OSS, Imatani Score, and EuroQol-5D score. The preoperative Cronbach $\alpha$, calculated using 70 patients, just reached an acceptable level (0.71). The postoperative Cronbach $\alpha$ showed higher internal consistency (0.87) and better responsiveness compared with the other shoulder outcome measures.

Evaluation of the NCS also identified issues with the inclusion of an item addressing cosmesis of the ACJ. The interim correlation was low (0.102), and with this item removed, the Cronbach $\alpha$ of the scale increased. Nonetheless, the authors decided to include this item based on the concept that one of the main benefits of operative management of Rockwood grade 3 ACJ dislocation is improved cosmetic satisfaction. The variability of the patient scores on the cosmesis item may increase the chance of overestimating or underestimating ACJ status because there are only 10 items on the scale.

The authors examined reproducibility but did not provide an MDC that would be beneficial for clinicians using the tool. Eighteen of the included patients completed retrospective assessments of outcome measures, which is increasingly considered problematic.

With preliminary validity of 2 ACJ-specific PROMs, future research of the SACS compared with the NCS should be completed to allow further improvements of both scales.

One limitation of the current study includes a relatively small study sample. Although 125 participants completed the questionnaire preoperatively, only 72 (58%) completed the questionnaire again postoperatively, and not all patients

<table>
<thead>
<tr>
<th>Table I</th>
<th>Scores and floor and ceiling effects of questionnaires</th>
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<tbody>
<tr>
<td>Questionnaire</td>
<td>No.</td>
</tr>
<tr>
<td>SACS</td>
<td></td>
</tr>
<tr>
<td>Presurgery</td>
<td>125</td>
</tr>
<tr>
<td>Postsurgery</td>
<td>72</td>
</tr>
<tr>
<td>SPADI</td>
<td></td>
</tr>
<tr>
<td>Presurgery</td>
<td>105</td>
</tr>
<tr>
<td>Postsurgery</td>
<td>51</td>
</tr>
<tr>
<td>OSS</td>
<td></td>
</tr>
<tr>
<td>Presurgery</td>
<td>106</td>
</tr>
<tr>
<td>Postsurgery</td>
<td>50</td>
</tr>
<tr>
<td>ASES</td>
<td></td>
</tr>
<tr>
<td>Presurgery</td>
<td>78</td>
</tr>
<tr>
<td>Postsurgery</td>
<td>49</td>
</tr>
</tbody>
</table>

SD, standard deviation; SACS, Specific AC Score; SPADI, Shoulder Pain and Disability Index; OSS, Oxford Shoulder Score; ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form.

<table>
<thead>
<tr>
<th>Table II</th>
<th>Correlations (Pearson $r$) between Specific AC Score and other shoulder questionnaires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire</td>
<td>Presurgery SACS ($r$)</td>
</tr>
<tr>
<td>Presurgery SPADI</td>
<td>0.82</td>
</tr>
<tr>
<td>Presurgery OSS</td>
<td>-0.61</td>
</tr>
<tr>
<td>Presurgery ASES</td>
<td>-0.74</td>
</tr>
<tr>
<td>Overall shoulder status, %</td>
<td>-0.58</td>
</tr>
</tbody>
</table>

SACS, Specific AC Score; SPADI, Shoulder Pain and Disability Index; OSS, Oxford Shoulder Score; ASES, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form.
completed all of the other questionnaires at both time points. These patients were lost to follow-up, and because the questionnaire was paper based and sent by mail, it was difficult to get patients to respond despite follow-up. This could be improved with future studies researching the SACS being performed online.

The small number of patients with copathologies found incidentally during surgery may have influenced the change in their SACS score. This number would not be expected to influence overall psychometric parameters and is reflective of clinical practice were concomitant pathology may be present.

Conclusions

The SACS can be recommended for use when measuring the effect of interventions for ACJ conditions because it is reliable, has evidence of criterion validity, high internal consistency, and provides a MDC that is helpful to both researchers and clinicians. It was systematically developed and found to be more responsive than the ASES, SPADI, and OSS for patients with ACJ issues.

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Disclaimer

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Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jse.2018.04.026.

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