

Evaluation of Rotator Cuff Repair Using Korean Shoulder Scoring System

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Background: Assessment of the clinical outcomes after rotator cuff repair is essential for their effectiveness on treatment. The Korean Shoulder and Elbow Society devised the Korean Shoulder Scoring System (KSS) for patients with rotator cuff disorder. The purpose of this study was to evaluate the availability of the KSS for assessment of clinical outcomes in patients after arthroscopic rotator cuff repair, and for comparison with other appraisal scoring systems.

Methods: A total of 130 patients with partial-thickness or full-thickness rotator cuff tear who underwent arthroscopic repair using a single row or double row suture bridge technique were enrolled. The average follow-up period was 25.9 months. All patients were classified according to various factors. Comparison within corresponding categories was performed, and the correlation between the KSS and other shoulder assessment methods including University of California Los Angeles (UCLA), Constant and American Shoulder and Elbow Surgeons (ASES) score was analyzed.

Results: Total score of the KSS response had increased from 59.6 preoperatively to 88.96 at last follow-up. All KSS domains, including function, pain, satisfaction, range of motion, and muscle power had improved up to 24 months postoperatively. Statistical significance was observed mainly in preoperative measurements with number and size of torn tendons, and greater than or equal to grade 3 of fatty infiltration. The KSS was best correlated with the UCLA scoring system in both preoperative ($r=0.785$) and postoperative ($r=0.951$) measurements.

Conclusions: The KSS was highly reliable and valid as a discriminative instrument, and it showed strong correlation with ASES and UCLA scoring systems.

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Key Words: Korean Shoulder Scoring System; Shoulder scoring system

Introduction

Assessment of surgical outcomes in patients with rotator cuff tear is essential to aid the clinical decision making and monitor quality of care with evidence that a treatment is effective.¹⁾ Various techniques have been introduced for repair of rotator cuff tear and proposed outcomes may have influenced their intention with regard to whether to strengthen the muscle power or to improve the range of shoulder motion. Therefore, a well-organized scoring system for evaluation of clinical outcomes is extremely demanding. There are a large number of assessment

instruments for use in evaluation of symptoms and function of the shoulder. Among them, the Constant score and the American Shoulder and Elbow Surgeons (ASES) questionnaire for the shoulder are well characterized and accepted in the scientific community.²⁻⁵⁾ Understanding each domain of these measurement tools is important to evaluation of clinical outcomes with appropriate patients. The Constant score is in widespread clinical use, particularly in Europe. However, because of low inter-rater reliability and concerns regarding validity, it is not suitable for instability patients and research studies.⁶⁾ The ASES score is a well-tested and helpful combination of self- and clinical assess-

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ment for rotator cuff disease; however, caution is required for patients with shoulder instability since pain is worth 50% of the overall score.^{6,7)}

In using outcome measures for postoperative evaluation, a clinician should be perceptible to these scoring systems which are valid, reliable, and responsive to the patients. Overall, to avoid biased interpretation of clinical results, a scoring system may have better to consist of both patient-oriented questionnaires and observer based clinical findings. The Research Committee of the Korean Shoulder and Elbow Society devised a scoring system known as the Korean Shoulder Scoring System (KSS) for patients with rotator cuff disorder.⁸⁾ It was believed that this system combined subjective and objective evaluations.

The purpose of this study was to evaluate the availability of the KSS for assessment of clinical outcomes in patients after arthroscopic rotator cuff repair, and for comparison with other currently used appraisal scoring systems. Our hypothesis was that the usefulness of the KSS for assessment of rotator cuff disease would be confirmed and that it would show similarity with other currently used scoring systems.

Methods

The Institutional Review Board of National Medical Center approved this study.

Patient Selection

From October 2008 to February 2010, a total of 130 patients with partial-thickness or full-thickness rotator cuff tear who underwent arthroscopic repair using a single row or double row suture bridge technique were enrolled in this study. The patients were followed for an average of 25.9 months. There were 81 males and 49 females with a mean age of 56 years. The average symptomatic duration was 14.9 months. All symptomatic patients who were available for KSS in the preoperative and postoperative period were included. Patients with revision surgery, glenohumeral arthritis who required total shoulder replacement, adhesive capsulitis who required capsular release or combined instability that might influence the outcomes of the study were excluded.

Patient Analysis with Various Factors

Enrolled patients were divided into various groups according to their dependent variables. The patients were separated according to the presence of a traumatic history. Patients with single and multiple tendon tears were evaluated. The number of torn tendons was confirmed by preoperative magnetic resonance imaging. Characteristics of the rotator cuff including fatty infiltration were measured using the grading system of Goutallier. Applicable patients were assigned to grade 0, 1, 2, 3, and 4. Actual size of tear was measured during arthroscopic surgery using

a calibrated probe in the scale of millimeters. Initial size of rotator cuff tear was categorized according to three groups; small, medium, and large-to-massive.

Functional outcomes were evaluated preoperatively and postoperatively at 3, 6, 9, 12, and 24 months using the KSS, ASES, University of California Los Angeles (UCLA), and Constant Scores. Comparison between preoperative and postoperative KSS with the above categories was performed, and the correlation between the KSS and other shoulder assessment methods was analyzed.

Statistical Analysis

Comparisons among categorical variables were performed using Student's t-test. Comparisons between preoperative and postoperative KSS were performed using Student's t-test. Pearson correlation coefficient was used for analysis of the correlation between KSS and other shoulder assessment methods. Statistical analysis was performed using SPSS software ver. 16.0 (SPSS Inc., Chicago, IL, USA), with a confidence interval of 95%.

Results

Preoperative Evaluation with the Korean Shoulder Scoring System

All enrolled patients were evaluated using the KSS at the time they first visited the hospital. The most abundant scores were distributed between 60 to 70 points with 57 patients (43.9%). The KSS response distribution with the percentage of patients is shown in Fig. 1.

Comparison with Korean Shoulder Scoring System Domains

Total score of the KSS response had increased from 59.6 preoperatively to 88.96 at last follow-up visit. All KSS domains including function, pain, satisfaction, range of motion, and muscle power had improved as the patients recovered up to 24 months

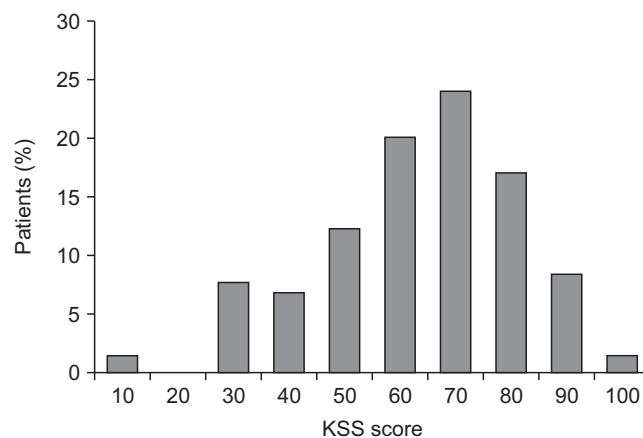


Fig. 1. The Korean Shoulder Scoring System (KSS) response distribution with the percentage of patients.

postoperatively. However, the domain of muscle power including strength and endurance showed a relatively slight increment compared to other domains. In the domain of range of motion, the overall internal rotation remained within a similar range from preoperative stage to final follow-up.

Comparison of Various Factors between Preoperative and Postoperative Korean Shoulder Scoring System

Total scores measured preoperatively and at 24 months postoperatively are summarized in terms of various factors in Table 1. Overall, the preoperative KSS showed a significant difference in each factor, however, there was no significant difference among the factors in postoperative KSS. A total of 77 patients had a traumatic history. The atraumatic group showed a significantly higher score than the traumatic group on preoperative KSS ($p < 0.001$). According to the number of torn tendons, there were 95 single and 35 multiple torn tendons. The preoperative KSS scores of patients with a single torn tendon were significantly higher than those for patients with multiple torn tendons ($p < 0.001$). According to the initial size of tear, there were 53 small, 48 medium, and 29 large to massive sized tears. The preoperative KSS scores of patients with small to medium sized tears were significantly higher than those for patients with large

to massive sized tears. ($p < 0.001$) Tendon thickness showed no significant difference whether it's partial or full-thickness at both preoperative and postoperative measurements. Regarding fatty degeneration of supraspinatus tendon using the Goutallier grading system, there were 7, 69, 27, 5, and 5 patients with respect to the Goutallier grading system 0, 1, 2, 3, and 4, respectively. Preoperative fatty degeneration greater than or equal to grade 3 of the Goutallier grading system showed a significantly inferior score in the preoperative KSS response ($p < 0.001$).

Correlation between the Korean Shoulder Scoring System and Other Assessment Methods

Overall preoperative KSS scores showed fair correlation with other assessment methods (ASES=0.647, UCLA=0.785, Constant score=0.573). As a discriminative instrument, the KSS showed strong correlation with ASES and UCLA scoring system and moderately strong correlation with Constant score. For evaluation of postoperative results, strong correlation was observed between the KSS and other methods (ASES=0.912, UCLA=0.951, Constant score=0.911). The KSS showed the best correlation with UCLA scores as shown in Table 2.

Discussion

Using the KSS, this study demonstrated its utility value and close correlation with other currently used assessment methods. In the preoperative KSS scores, most patients were assigned within 60 to 70 points. Total KSS scores and each domain had increased linearly from preoperative evaluation to final follow-up at 24 months. The statistical significance showed mainly in preoperative measurements with presence of trauma, multiple torn tendons, large to massive sized tear, and greater than or equal to grade 3 of fatty infiltration. Postoperative measurements showed no significant difference in any variables. The KSS best correlated with the UCLA scoring system in both preoperative and postoperative measurements.

There are many instruments used for evaluation of symptoms and functions of the shoulder which represent disease status.⁹⁻¹²⁾ There is no appropriate evaluation tool for the shoulder condition. The Research Committee of the Korean Shoulder and

Table 1. Comparison between the Preoperative and Postoperative Korean Shoulder Scoring System Scores in Various Factors

Variable	Preoperative (point)*	Postoperative (point)
Presence of trauma		
Traumatic	57.8	87.3
Atraumatic	62.0	91.7
No. of torn tendon		
Single	62.5	90.2
Multiple	49.6	86.3
Initial tear size		
Small	62.6	90.9
Medium	61.5	90.1
Large-to-massive	48.7	83.8
Tendon thickness		
Partial	63.5	91.9
Full	58.2	88.8
Fatty degeneration		
Grade 1	61.9	89.2
Grade 2	62.7	91.8
Grade 3	48.3	94.0
Grade 4	39.2	78.5

*All preoperative measurements of various factors showed statistical significance with p -value of less than 0.05.

Table 2. Correlation between the Korean Shoulder Scoring System and Other Assessment Methods

Variable	Preoperative (r)	POD # 24 months (r)
ASES	0.647	0.912
UCLA	0.785	0.951
Constant score	0.573	0.911

r: correlation coefficient, ASES: American Shoulder and Elbow Surgeons score, UCLA: University of California Los Angeles score, POD: postoperative days.

Elbow Society has designed to provide a standardized method for evaluation of rotator cuff disorder for achievement of close to ideal shoulder assessment. This assessment tool is distinguished from other widely used assessment tools. This method emphasized patient-oriented self-evaluation to avoid bias produced by observer-based evaluation and added the muscle endurance domain, which was included only in the KSS.⁶⁾ A total of 100 points can be acquired with a perfectly healthy shoulder on the KSS, which is composed of a questionnaire section for the patient and physical examination section for the clinician including 5 domains. Each domain is distributed as function (ability to perform the activities required for daily living, 30 points), perception of pain (20 points), satisfaction with the affected shoulder condition (10 points), range of motion (20 points), and muscle power, comprising peak strength (10 points) and endurance (10 points). KSS also showed acceptable internal consistency preoperatively and postoperatively, and each item score showed excellent correlation with total KSS scores. With respect to content validity, it showed excellent validity with no floor or ceiling effects since the lowest and highest scores were compatible for assessment of the patient's level of ability during follow-up.⁶⁾

In all data collected from our study, statistical significances were seen in preoperative measurements except the comparison between patients with partial and full-thickness rotator cuff tear. Based on our results, the KSS appeared to work in accordance with common sense. It is usually thought that the patient with a traumatic history complains of more pain after frank injury than the patient with degenerative tear whose symptoms arise insidiously. Likewise, patients with multiple torn tendons, initially large-to-massive tear, and more fatty degeneration would be supposed to have more painful symptoms and lower shoulder function. Remarkably, the KSS provided satisfactory outcomes that could be shared with ordinary assumptions. This confirms that the KSS is highly reliable, particularly in assessment of preoperative shoulder condition.

The KSS may have been valid as a discriminative instrument, however not as an evaluative instrument. Our data showed that all significant differences were shown in preoperative KSS response, not postoperative KSS. Accordingly, it would be better to use the KSS to assess the patient's level of ability before surgery rather than postoperative conditions of the patient. It may be that most patients who underwent arthroscopic rotator cuff repair showed acceptable clinical outcomes in every domain of the KSS. Nevertheless, further analysis of the KSS according to values of normal shoulders and normalization related to age and gender differences may be needed.

From the original article introducing the KSS, the Korean Research Committee found the best correlation with the Constant score as a discriminative instrument and the ASES score as an evaluative instrument.⁶⁾ This study showed that the KSS was best fitted with the UCLA score in both discriminative and evalua-

tive instruments. However, the Constant score was modest with preoperative measurement, contrary to the original article. This result was unexpected, since the UCLA scoring system was originally devised for evaluation of shoulder arthroplasty rather than rotator cuff disease. However, regardless of the main focus on the UCLA score system, the domains of the UCLA score were built in a similar manner with the KSS. The UCLA scoring system is composed of pain, function, active forward flexion, strength of forward flexion, and patient satisfaction as the KSS is composed of function, pain, satisfaction, range of motion, and muscle power, respectively. Although the distribution of weighted points differs from that of the KSS, an analogous effect is likely produced by the similar design of assessment. It is not necessary to compare the relationship between the KSS and other methods in postoperative measurements due to the fact that no statistical significance was shown as mentioned earlier.

Among various factors investigated in this study, a significantly inferior score in the preoperative KSS response was noted in patients with large to massive tear and preoperative fatty degeneration greater than or equal to grade 3 of the Goutallier grading system. McElvany et al.¹³⁾ analyzed the systematic review of 2383 articles to identify evidence on the prognostic factors after rotator cuff repair, and concluded that increased risk of failure of rotator cuff repair was associated with more fatty infiltration and larger to massive tear size. Thus, more concern regarding treatment strategies should be given to patients with a relatively low score in the preoperative KSS response by reviewing all parameters. This confirmed that the KSS might act as a discriminative instrument with high compatibility.

One limitation of this study was that measuring an objective item such as range of motion or muscle strength could be interrupted by clinicians. It may be fully objective from the clinician's point of view; however it can be highly subjective from the patient's point of view. Second, emotional intervention of the patient can occur during the assessment. This is an inevitable consequence of measuring subjective evaluation since the KSS literally consists of patient-oriented self-evaluation. Thus, the Korean Research Committee should give more effort to establishment of a firm criterion.

Conclusion

In general, the concept of the KSS to include more patient-oriented questionnaires rather than observer based clinical findings was well-developed with their purposes. This new concept is believed to reinforce the existing methods for patient involvement in incorporative treatment with clinicians. However, the KSS seems more appropriate for use as a discriminative instrument than an evaluative instrument.

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