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American Shoulder and Elbow Surgeons score: what does it tell us about patients selecting operative treatment of a rotator cuff injury?



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Background: As shared decision-making rises in importance and minimum clinically important differences become benchmarks for treatment success or failure based on the increased usage of patient-reported outcomes, it is important to understand the breadth of starting points for patients as that should affect the interpretation of individual postoperative score changes.

Methods: This is a retrospective data review of prospectively collected American Shoulder and Elbow Surgeons (ASES) score of patients electing to undergo rotator cuff repair with 1-year follow-up. A residual improvement: possible to achieve ratio (RIPAR) was calculated to demonstrate what percent of maximal possible improvement was gained at 1 year. A minimal clinically important difference (MCID) of 12 was used.

Results: Three hundred thirty-five patients with an age range of 32–79 years form the population. Baseline ASES score ranged from 0 to 97.5, with a mean of 47.8. At 1 year, the mean was 84.7 (range, 30–100). There was no statistical difference by age, but men reported more overall preoperative dysfunction than women (50.3 vs. 44.1, $P < .001$). The RIPAR was on average 67%. Seventy-eight percent of the population demonstrated RIPAR scores >50% which showed improvement of over half of their preoperative deficit. Eighty-nine percent of patients achieved a positive MCID and 3% achieved a negative MCID.

Conclusions: The ASES scores showed a broad range of baseline scores for patients choosing to undergo rotator cuff repair highlighting the need for individual patient rather than population review of patient-reported outcome measures. As shared decision-making is taking on a larger role in clinical care, it is important to counsel patients accurately. Evaluating the ASES score by MCID and maximal possible improvement provides different population perspectives with the concept of RIPAR allowing for personalization of decision-making on the individual patient level.

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Patient-reported outcome measures (PROMs) were developed to give the patient and clinician a methodologically sound measure of a patient's subjective assessment of function. Theoretically, this information encourages shared treatment decision-making during a clinician-patient interaction as well as functioning as a tool for clinicians to monitor impact of surgical care.

This project was conducted with only anonymized data and thus is exempt from institutional review board approval.

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For the clinician-patient interaction to effectively use baseline PROMs, an understanding of the specific PROM and how it records function relative to the specific injury or disease is required. Each PROM may present a different overall patient profile for each disease as well as by sex and age even if used for multiple diagnoses. Women and men report severity differently.^{2,7} Baseline function and ease of performing tasks will vary by age.

Each PROM has unique attributes including minimal clinically important difference (MCID), threshold, and ceiling effect. It is therefore important to understand how all these characteristics impact scores and to maximize the use the PROMs when counseling the individual patient. Unfortunately, in recent years, there has been more emphasis on collecting these PROMs than how to actually interpret the results on the individual patient level.

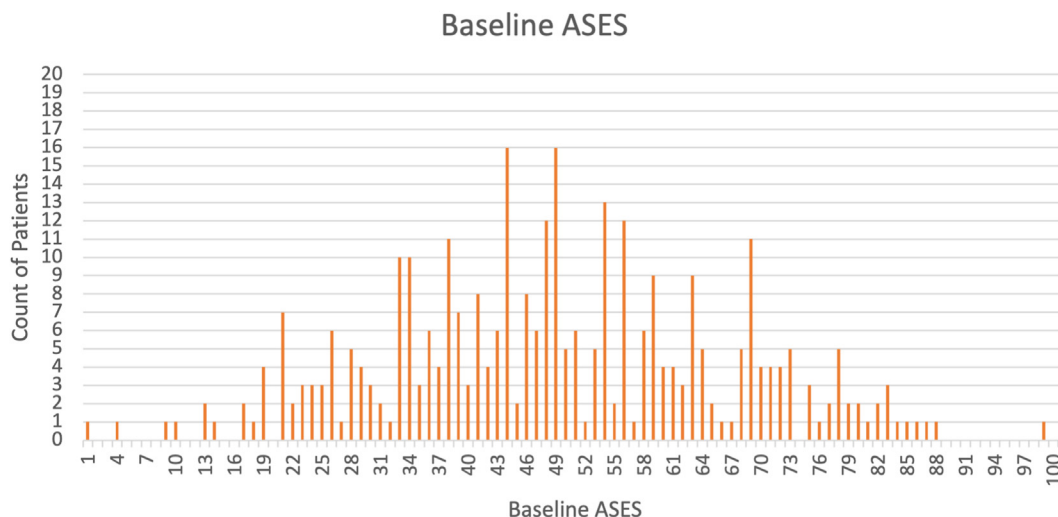


Figure 1 Distribution of baseline ASES scores by patient count. ASES, American Shoulder and Elbow Surgeons.

Table I
Baseline PROM scores by age.

	≤60 years mean	60+ years mean	P value
Baseline VAS (0-10)	4.7	4.8	.91
Baseline ADL (0-50)	13	13	.85
Overall ASES score	48	48	.85

PROM, patient-reported outcome measures; VAS, visual analog scale; ADL, activity of daily living; ASES, American Shoulder and Elbow Surgeons. For VAS, and ADL, lower is worse pain and worse function.

Table II
Baseline PROM scores by sex.

	Male mean (N = 135)	Female mean (N = 200)	P value
Baseline VAS (0-10)	5.1	4.5	.02
Baseline ADL (0-50)	11.6	13.8	.002
Overall ASES score	44.1	50.3	<.001

PROM, patient-reported outcome measures; VAS, visual analog scale; ADL, activity of daily living; ASES, American Shoulder and Elbow Surgeons. For VAS, and ADL, lower is worse pain and worse function.

The primary purpose of this project is to explore the variation in baseline American Shoulder and Elbow Surgeons (ASES) scores in a population with chronic rotator cuff disease who elected to undergo surgical repair. The secondary purposes were to determine the magnitude of change at 1 year in relationship to baseline function and the impact of various interpretative tools for PROMs. Ultimately, the goal was to provide patients with better understanding on expected outcome with regard to their initial function.

Materials and methods

We investigated the variation in baseline scores within a population of chronic rotator cuff tears who completed an ASES score⁸ at baseline and 1 year and selected operative treatment. A chronic disease was chosen under an assumption that all patients would demonstrate dysfunction at their preoperative baseline point and demonstrate some magnitude of improvement from operative intervention. This entire cohort of patients, irrespective of their baseline PROM score, chose surgical intervention because of their self-perceived deficits in their shoulder.

All patients evaluated at a free-standing orthopedic clinic and scheduled for surgical treatment of their chronic rotator cuff disease (defined as a history of symptoms >3 months with a rotator cuff tear visible on magnetic resonance imaging) were screened. Those with a complete ASES score (in-person or via e-mail) both prior to their surgery and at 1-year follow-up formed the study population. Data were retrospectively taken from the medical record via a Current Procedural Terminology code search.

Surgical care was provided by multiple orthopedic surgeons at multiple different surgical centers; however, all clinical follow-up was provided at the same outpatient clinic with postoperative management dictated by individual surgeon preference.

Analysis of patient-reported outcomes was done with descriptive statistics (SPSS, version 27; IBM, Armonk, NY, USA). All data were anonymized prior to availability for this study and analysis and was institutional review board exempt.

Ages were categorized as ≤60 and 61+. Individual question responses were reviewed to determine if a specific function might be more reflective of rotator cuff dysfunction and impacted by surgical treatment. ASES score ranges from 0 to 100, with 0 the lowest level of function and 100 the highest level of function. The ASES score has 2 subscores: activity of daily living (ADL) and a pain visual analog scale (VAS) but is reported as one overall score. The function score has 10 questions (0-3), with 0 the worst function and 3 the best function. The VAS ranges from 0 (no pain) to 10 (worst pain). The 2 combine formulaically, each contributing half the score, with the higher the total overall scores the better the function. Thus, the one VAS has equal weight to the 10 function questions and accounts for half of the score.

The literature reports an MCID of 12-17 points for nonoperative treatment⁹ of rotator cuff disease and 27 points for patients undergoing arthroscopic rotator cuff repair¹⁰ on the ASES score. The MCID is the number used to define what the smallest change in a patient-reported outcome form is noticeable to the patient as identified by change in function. An MCID of 12 was used for all analysis as 27 points is more than one-fourth of the scale and would have left 10% of our population with inadequate room to achieve the MCID from baseline.

Percent change in score was calculated between baseline and 1 year to determine directionality and magnitude of change. To put the individual patients' baseline score in context relative to their decision to undergo surgical repair of their rotator cuff tear, the

Table III
Percentage of patients who endorsed individual ASES items at baseline.

	Put on coat (%)	Sleep on affected side (%)	Wash your back (%)	Manage toileting (%)	Comb your hair (%)	Reach a top shelf (%)	Lift 10 lbs (%)	Throw overhand (%)
Unable to do	5	26	29	4	11	37	58	57
Very difficult to do	31	35	38	16	22	27	23	28
Somewhat difficult to do	54	33	25	30	36	29	12	9
Not difficult	9	6	8	49	31	9	8	5

ASES, American Shoulder and Elbow Surgeons.

Table IV
Average percent change by baseline ASES score categories.

Baseline ASES score	N	Average percent change	Range
0-19	14	777	164-4400
20-29	37	239	17-388
30-39	57	135	17-209
40-49	84	91	-31 to 155
50-59	58	67	3-97
60-69	43	44	-41 to 67
70-79	28	9	-58 to 43
80-89	13	4	-60 to 25
90+	1	-4	-4

ASES, American Shoulder and Elbow Surgeons.

maximal possible improvement (MPI) in their PROM score was calculated.⁶ The MPI is the amount that an individual patient could gain between their baseline score and a perfect score on any given PROM. To further individualize the patients' PROM, a residual improvement: possible to achieve ratio (RIPAR)^{6,10} was calculated to demonstrate what percentage of the MPI was gained at 1 year. This calculation is variously referred to in the literature as percentage MPI and maximal outcome improvement.^{1,6,10} This number reflects the percentage of change that a subject gained or lost relative to the maximum amount of PROM gain possible from their baseline state. eg, a patient being evaluated with a 100-point PROM scale whose baseline score is 30 would have an MPI of 70. If the same patient has a 1-year PROM of 87, then their RIPAR would be 81% (Supplementary Appendices S1 and S2).

Results

Between April 2018 and January 2020, 335 completed a baseline and 1-year ASES score and form this population. There were 135 (40%) males and 200 (60%) females. The average age at the time of surgery was 60 years (range, 32-79 years). Eighty percent of the population was between 48 and 70 years.

Baseline outcomes

The preoperative ASES score had a mean of 47.8 and a median of 46.7 (range, 0-97.5). Evaluating ceiling and floor effects, it was found that 10% of the population had scores <25 indicating significant limitation of function and 10% of the population had scores >71.5 indicating minimal limitation of function. Three patients had an overall ASES score of 0 at baseline, reporting 0 for ADLs and 1 for pain. One patient had an overall ASES score of 97, reporting a VAS of 5 and a function of 30. Fig. 1 demonstrates the spread of baseline ASES score.

To determine if the ADL or the VAS portion of the ASES score provided a more clear indication of what drove patients to choose surgical treatment, the 2 components of the ASES score were analyzed independently.

The raw ADL scores at baseline ranged from 0 (worse function) to 30 (best function) with a mean of 12.9, and the raw VAS ranged

from 0 (least pain) to 10 (worst pain) with a mean of 4.8. One percent of the population reported no dysfunction at baseline (ASES score = 30). Sixteen percent of the population reported minimal to no pain at baseline (<2).

One hundred fifty-five (46%) patients were ≤60 years of age at baseline and 180 (54%) patients were 61+ years of age. Table I demonstrates no significant difference in baseline scores by age for overall and domain scores. There were significant differences in preoperative ADL and VAS based on sex, with males reporting higher VAS preoperatively and lower functional scores (Table II).

To evaluate if there was one question in the ASES score that might specifically highlight rotator cuff dysfunction and provide a more clear indication of patient functional limitations, a review of individual questions was undertaken. Of the 8 functional items in the ASES score, 5 (sleep, wash your back, reach a top shelf, lift 10 lbs., and throw overhand) had a majority of the functional limitations recorded as unable to or very difficult to do. By 1 year, the majority of patients reported no difficulty with all activities, indicating that activities evaluated by the ASES score improve with rotator cuff repair (Table III).

To evaluate percent change between baseline and 1-year ASES scores, the group of 335 with a baseline and 1-year ASES scores had a median improvement of 79%. Ten percent of the patients had less than 17% improvement, and 10% of the patients had more than 210% improvement (Table IV).

Eighty-nine percent of patients achieved a positive MCID and 3% achieved a negative MCID. Fig. 2 shows the percentage of patients who achieved the MCID of 12 over 1 year on the ASES scores grouped by their baseline ASES scores. Only 1 patient had a baseline score above 88 and thus inadequate room to achieve the MCID of 12.

The 1-year ASES scores for this population had an overall mean of 84.7 (range, 30-100) and a median of 91. 7.5% of the population reported a decrease in function between 1% and 61%, and 59% of the population reported more than 100% improvement.

The RIPAR (Fig. 3) was on average 67% (median, 83%). Ninety-four percent of our patients had a RIPAR that was positive. Assessing the magnitude of individual patient potential, 78% of our population demonstrated RIPAR scores > 50%, indicating that these patients showed improvement of over half of their preoperative deficit. Of the 5% of subjects who had a negative RIPAR value, 33% were less than -100%, implying that they reported functional decline by the same magnitude as they potentially had to gain at baseline. The average percentage of MPI was -11% (median, -10%).

Discussion

Evaluating the ASES score by MCID and MPI provides different population perspectives with the concept of RIPAR allowing for personalization of decision-making on the individual patient level.

In our series, all patients chose to undergo operative treatment of their chronic rotator cuff tears despite wide variation in preoperative PROM scores. This demonstrates that something in each patient's baseline state is dysfunctional or painful enough to

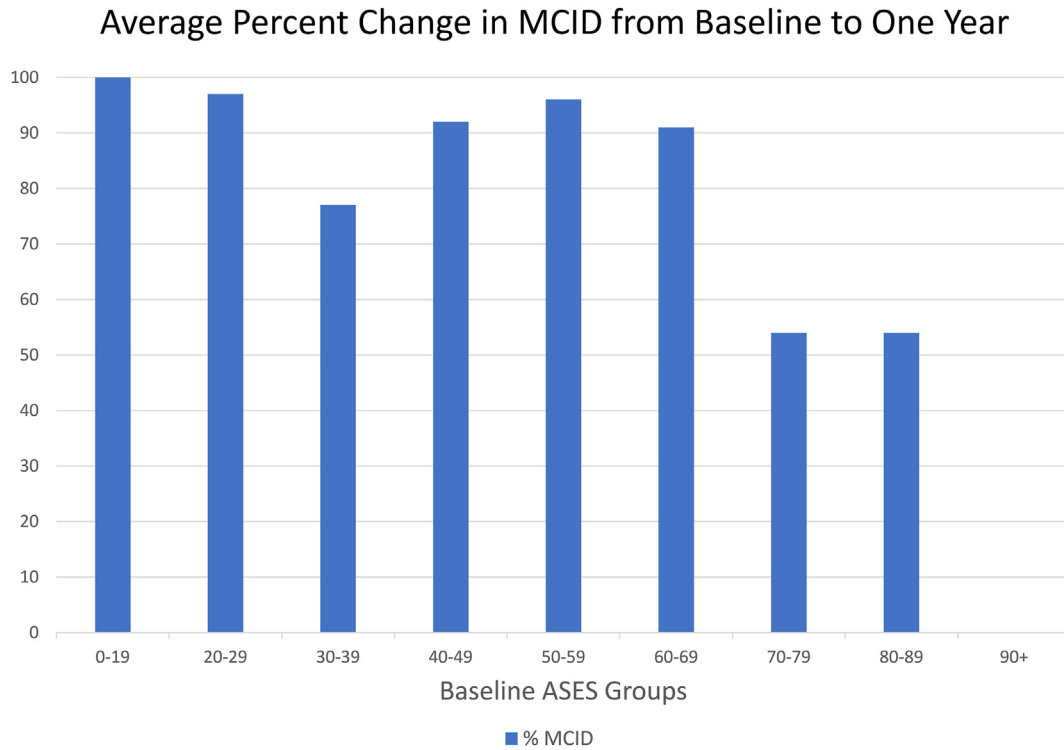


Figure 2 ASES score change from baseline to one year. MCID, minimal clinically important difference; ASES, American Shoulder and Elbow Surgeons.

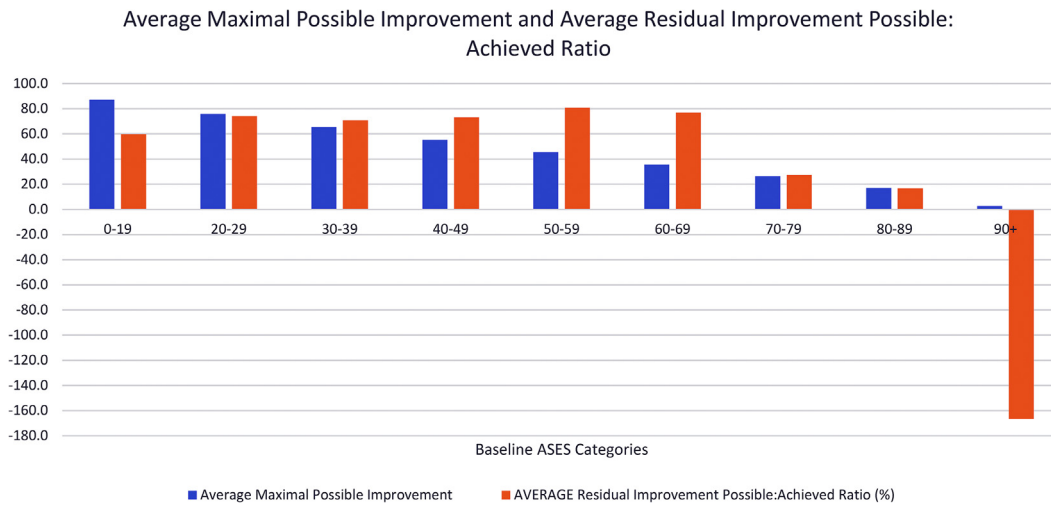


Figure 3 Maximal possible improvement and residual improvement possible: achieved ratio. ASES, American Shoulder and Elbow Surgeons.

warrant choosing surgical repair and just evaluating the individual score may be inadequate. Baseline ASES scores ranged preoperatively from 3 patients reporting complete dysfunction to 1 patient reporting no measurable dysfunction. The mean baseline ASES score in our cohort was 48 (median, 47) and the mean baseline VAS was 5 (median, 5) which are consistent with other literature on this population.⁵ The variability in these scores throughout the group demonstrates a wide spectrum of disability and pain. While there was no statistically significant difference in baseline ASES score by age (≤ 60 , $61+$), there was a statistically significant difference in baseline ASES score by sex contradicting the concept that women tend to report more symptoms than men.^{3,4,7} The difference between the sexes was 6 points so its clinical importance is debatable

as is whether this difference is due to a different tolerance for dysfunction. The overall ASES score improved for all but 13 patients. This is particularly important to remember when evaluating function on a Likert scale. Patient self-assessment of function over time is impacted by changes to their internal scales of pain and expectations of activity modification.

Using the MCID of 12 as a benchmark, 298 patients achieved this goal in the positive direction, while 10 had a 12+ point drop in the negative direction. Ten percent of patients would have started with insufficient room to improve had we used the literature benchmark of 27 points. Evaluating patient scores by using the MCID for patients undergoing nonoperative treatment of rotator cuff repairs, there are still 8 patients not presenting with enough preoperative

dysfunction to achieve the MCID. Using the MCID for patients undergoing arthroscopic repair (27-point change), 7.5% of our population could not have achieved the benchmark for clinical improvement. This concept is critically important when discussing surgery in a patient-centric environment because many of these patients' baseline state is still dysfunctional enough to select surgical treatment. It is not a score which determines whether a patient's shoulder is "good enough" rather the subjective experience of the patient at baseline in conjunction with adequate preoperative counseling that helps decide the best treatment. Looking at whether a treatment helps move the patient toward successful resolution of their baseline deficit (ie, a RIPAR near 100%) can further the understanding of why some "highly scoring" patients still select surgery. This group of patients warrants further exploration to understand why they are choosing surgical intervention despite shoulders which research would imply should be indiscernible from normal. Looking at the overall improvement of the pretreatment deficit can allow for comparison of PROMs as they measure the patient decision-making process and the patient's response to the treatment selected.

Using the concept of RIPAR allows for personalization of decision-making on the individual patient level, irrespective of the PROM used. Like other concepts in the literature, we feel this term is more descriptive and worded distinctively eliminating terminology confusion. It allows for evaluating patients regardless of whether an MCID has been determined for a specific PROM with a specific disease state at a specific time point. Using the individual patient's self-determined level of disability at baseline can allow for situations in which commonly accepted PROM benchmarks might not be capable of satisfying the needs of the individual patient. This could enhance data-driven patient-centric discussion of surgical risks. Using this method of analysis, 78% of our patients achieved at least 50% improvement of their MPI, implying that the deficiencies in their shoulder were reduced by half with surgery and recovery.

If there is a difference between the subject's preoperative state and their perceived normal, we wanted to know how frequently surgery achieved the goal of making them closer to the normal state as detected by ASES scores. We looked at baseline scores and 1-year scores and established a ratio of what possible improvement on ASES scores existed relative to their actual improvement at 1 year. This RIPAR could therefore be positive (ASES score increased from baseline to 1 year) or negative (ASES score at 1 year is lower than baseline). This ratio varied from -3.29 to 1 in our data set. The lowest scores on this scale imply that patients were worse on their ASES score at 1 year by more than 325% of the detectable PROM deficit that existed at their baseline. A RIPAR of 1 indicates that a patient achieved 100% of the increase possible from their baseline to a perfect PROM score at 1 year (100 points). This information can be useful in setting patient expectations as only 19% of our patients achieved a 100% RIPAR but over three-quarters of our patients demonstrated RIPAR scores > 5 which showed improvement of over half of their preoperative detected deficit.

Eighty-nine percent of patients improved by at least 1 MCID, while 3% worsened by at least 1 MCID. Those patients who saw a negative clinically significant difference should be evaluated as carefully as those who do not achieve the MCID or do so in the positive direction.

Conclusion

Understanding how to interpret PROMs remains difficult in a clinical setting. The ASES score showed a broad range of baseline

scores for a group of patients choosing to undergo rotator cuff repair. In this population, a majority of patients demonstrated functional improvement at 1 year regardless of age or sex. The RIPAR and MPI were devised to frame clinical decision process on the individual patient experience rather than the raw PROM results. Evaluating our cohort with a wide variety of scores using MCID, RIPAR, and MPI all provide different population perspectives that should be taken into consideration when evaluating patient-reported outcomes as a measure of clinical care. As shared decision-making is taking on a larger role in clinical care, it is important to counsel patients accurately. Analyzing the patient's preoperative function using these different perspectives may help frame the conversation with the patient to form realistic expectations and ultimately lead to improved satisfaction.

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Supplementary data

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