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Patient-reported outcome tools and baseline scores vary by country and region for arthroscopic repair of massive rotator cuff tears: a systematic review

Javier Ardebol, MD, MBA, Kassem Ghayyad, MD, Simon Hwang, MD, Theresa Pak, MD, Mariano E. Menendez, MD, Patrick J. Denard, MD*

Shoulder Surgery, Oregon Shoulder Institute, Medford, OR, USA

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Background: Different patient-reported outcome (PRO) tools are used in patients with arthroscopic rotator cuff repair (ARCR) which complicates outcome comparisons. The purpose of this systematic review was to compare PRO usage and baseline scores across world regions and countries in patients with ARCR of massive rotator cuff tears (MRCT).

Methods: A systematic review was performed on ARCR for MRCT. The search was conducted from September to November of 2022 using the MEDLINE database for articles published in the last 15 years. Thirty-seven articles were included after initial screening and full-text review. In each article, PRO usage, baseline scores, and country of origin were collected. PRO usage was reported in percentages and baseline scores were normalized for each region to facilitate comparisons. Normalization was performed using the PRO means from each article. These averages were converted to fractions using the worst and best possible scores. These were combined into a single numerical value, expressed as a decimal from 0 to 1, using the total sample size for each tool per region. Values closer to 0 represent worse functional outcomes.

Results: Thirty-two percent (n = 12) of articles were from Asia, 43.2% (n = 16) from Europe, 5.4% (n = 2) from the Middle East, and 18.9% (n = 7) from North America. The most commonly reported PRO tools were American Shoulder and Elbow Surgeons (ASES) in 19 papers, Constant–Murley Score (CMS) in 26 papers, Visual Analog Scale for pain (VAS) in 19 papers, and University of California in Los Angeles (UCLA) in 11 papers. ASES was reported in 51% of articles with 63% being from Asia (n = 12) compared to 21% from North America (n = 4). CMS was reported in 70% of studies with 58% being from Europe. Upon normalization, the preoperative score ranged from 0.30 to 0.44. Europe (0.39), and North America (0.40) showed similar scores. The lowest and highest scores were seen in the Middle East (0.3) and Asia (0.44) respectively.

Conclusion: There is no standardized method to report outcomes in patients undergoing ARCR for MRCT. Great variation in usage exists in PROs which complicates data comparison between world regions. With normalization, baseline scores where similar among Asia, North America, and Europe, and lowest in the Middle East.

The growing interest in value-based care has shifted attention towards patient-reported outcome (PRO) tools to report clinical improvement.[20] In shoulder surgery, there are at least 25 distinct tools with varying degrees of validity, reproducibility, and responsiveness.[1,2,18,31] No tool has been consistently documented and high variability exists in the literature.

PRO measures have different countries of origin. This difference in origin could lead to a predominance of PRO usage in certain regions. Ashton et al showed in their systematic review of outcome measurement use in shoulder surgery for multiple pathologies increased Constant–Murley Score (CMS) and American Shoulder and Elbow Surgeon score (ASES) use in Europe and North America respectively.[4] However, reports in other world regions and countries are lacking. Additionally, preoperative scores may vary

Institutional review board approval was not required for this systematic review.

*Corresponding author: Patrick J. Denard, MD, Oregon Shoulder Institute, 2780 E. Barnett Road Suite 200, Medford, OR 97504, USA.

E-mail address: pjdenard@gmail.com (P.J. Denard).

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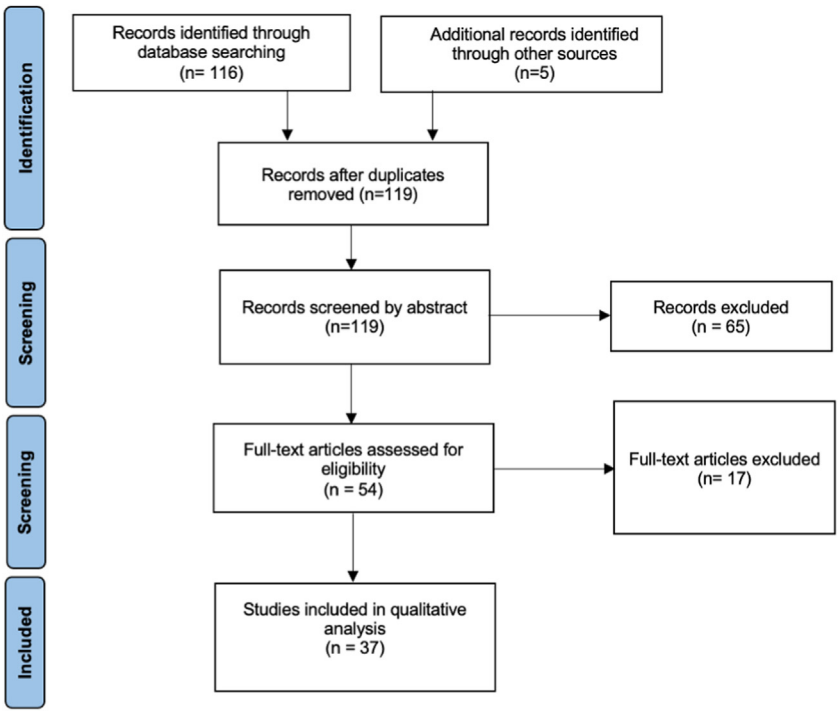

Figure 1 Flow diagram for study selection. Articles were initially screened by abstract, with subsequent review of remaining articles in full text.

showing different points where patients decide to undergo surgery (ie, surgical threshold),[39] especially when healthcare disparities are taken into account.[1] To the best of our knowledge, there are no available studies comparing surgical thresholds for massive rotator cuff tears (MRCT) between countries using PROs at baseline.

The purpose of this systematic review was to compare PRO usage and baseline scores across world regions and countries in patients undergoing arthroscopic repair (ARCR) of MRCT. Our hypothesis was that PROs usage would vary between North America and Europe.

Methods

Search strategy

A systematic review was conducted as per the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines and registered in PROSPERO. The search was performed utilizing the MEDLINE database on September 28th, 2022. The strategy employed was based upon the following search terms: "Rotator Cuff/surgery" [Mesh] AND "Rotator Cuff Injuries" [Mesh] AND "irreparable rotator cuff tear*" [tiab] OR "massive rotator cuff tear*" [tiab] OR "massive cuff tear*" [tiab] OR "irreparable cuff tear*" [tiab]. Furthermore, the reference section of each relevant article was reviewed to identify studies otherwise not populated during the primary search.

Study selection

The search was limited to articles written in the English language with a level of evidence I-IV published in the last 15 years. Case reports, abstracts, biomechanical studies, technical notes, virtual simulation studies, expert opinions, and cadaveric studies were excluded. Inclusion criteria consisted of human adult participants with MRCTs who underwent ARCR in a single world region with reported baseline and postoperative PROs. Articles with nonadult participants and unspecified PROs or location were excluded from analysis. The initial search provided 116 results. After duplicate removal, abstracts were manually screened for eligibility. Articles were subsequently assessed for inclusion and exclusion criteria. Thirty-seven articles were selected for study inclusion (Fig. 1).

Literature review

The literature search was conducted by 1 author (JA). Full-text reviews for studies meeting eligibility criteria were performed. The articles in question were discussed among authors to determine study inclusion. Data extraction followed a systematic approach along with a thorough assessment for bias. Demographic information such as author, year of publication, region, country, and the sample size was extracted from each article. In addition, the preoperative and postoperative PRO scores were collected from each study. PROs were limited to ASES, CMS, VAS, Simple Shoulder Test (SST), Disabilities of Arm, Shoulder, and Hand (DASH), Single Assessment Numeric Evaluation (SANE), Oxford Shoulder Score (OSS), Western Ontario Rotator Cuff index (WORC), UCLA, and Japanese Orthopedic Association (JOA), as these were most consistent among studies.

Statistical analysis

Weighted means were calculated for continuous preoperative and postoperative variables (PROs) based on the article's mean and total amount of patients in each region and country. These weighted means were used to normalize preoperative scores and improvement based on country and region. PROs where high scores correlate with good functional outcomes were calculated as follows: ((mean score in article−worst possible score)/(best possible score))*100%. Tools where low scores correlate with good functional outcomes were calculated with the following: ((worst possible score−mean score in article)/(best possible score))*100%.

These percentages were combined to provide a single value ranging from 0 to 1, with 0 representing worse scores. In addition, the number of articles was calculated for each region and country as well as the number of times where a particular PRO was used. These data were analyzed descriptively.

Results

Articles PROs per region and country

Thirty-seven studies were identified for final inclusion.[3,5-15,17,19,21-30,32-38,40,41,43-46] The studies consisted of a level of evidence I-IV. Of these, 32.4% (n = 12) were from Asia, 43.2% (n = 16) from Europe, 5.4% (n = 2) from the Middle East, and 18.9% (n = 7) from North America (Table I). South Korea contributed 75% (9 of 12) of articles from Asia. Eighty-six percent (6 of 7) of North American articles originated from the United States.

The most commonly reported PROs were ASES, CMS, VAS, and UCLA scores (Tables II and III). ASES was reported in 51% (n = 19) of articles with the majority being from Asia. Studies from Asia utilized ASES in 83% of articles. CMS was reported in 70% (n = 26) of studies with 58% being from Europe. VAS, seen in 19 articles, was used in 75% of studies from Asia (9 of 12) compared to 38% from Europe (6 of 16). In North America (n = 7), UCLA (43%) and ASES (57%) were reported in nearly half of studies.

Normalized PROs

Upon normalization, the preoperative scores ranged from 0.30 to 0.44 with the Middle East and Asia being the lowest and highest respectively (Fig. 2 and Table IV). Europe (0.39) and North America (0.40) had similar normalized scores which demonstrated comparable preoperative PROs scores. In the Middle East, patients had lower ASES, and higher VAS scores compared to other regions. The preoperative to postoperative improvement in normalized scores ranged from 0.33 to 0.38, showing similar overall improvement in functional outcomes between all regions (Table V).

Table I
Articles by region.

Region	N	%
Asia	12	32
Europe	16	43
Middle East	2	5
North America	7	19
Total	**37**	

Table II
Patient-reported outcome usage frequency.

Most commonly reported PROMs		
	N	%
ASES	19	51
CMS	26	70
CMS (adj)	3	8
qDASH	2	5
DASH	3	8
SSV	7	19
SPADI	2	5
OSS	1	3
SST	1	3
VAS	19	51
WORC	3	8
UCLA	11	30
JOA	1	3

PROM, patient reported outcome measures; *ASES*, American Shoulder and Elbow Surgeons; *CMS*, Constant-Murley Score; *CMS (adj)*, adjusted Constant-Murley Score; *qDASH*; Quick disabilities of the arm shoulder and hand; *DASH*, disabilities of the arm shoulder and hand score; *SANE*, single assessment numeric evaluation; *OSS*, Oxford Shoulder Score; *SST*, simple shoulder test; *VAS*, visual analog scale; *WORC*, Western Ontario Rotator Cuff index; *UCLA*, University of California Los Angeles, *JOA*, Japanese Orthopedic Association; *SSV*, subjective shoulder value; *SPADI*, shoulder pain and disability index.

Discussion

In this systematic review, we assessed PROs use by region and country as well as baseline functional scores before undergoing ARCR of MRCT. The primary findings of this study were that while ASES was most commonly used in Asia, CMS was most commonly reported in Europe. In North America, UCLA and ASES were the most frequently used PROs. Contrary to the study hypothesis, the pooled data suggested comparable surgical thresholds between Europe, Asia, and North America.

Currently, there is great variability among functional outcome tools in shoulder surgery. In their systematic review, Ashton et al investigated the most commonly used PROs and associated demographic variables in shoulder surgery for various pathologies.[4] Of the identified articles, 180 met the inclusion criteria where they found 35 shoulder-specific outcome measurements. Of these, CMS, ASES, SSV, SST, and UCLA were utilized in more than 10% of articles and were linked to the country of study origin. Similar to our study, ASES and CMS were mostly utilized in North America and Europe respectively. These findings demonstrate a lack of standardization in functional outcome measurements. While ASES, SSV, SST, and VAS are entirely subjective, CMS and UCLA require an in person clinical examination.[4,31] The former PROs may be performed through questionnaires at home which may facilitate achieving higher response rates. The requirement for CMS to be used in meetings and publications may explain the increased use of CMS in Europe. This heterogeneity could be assessed to standardize outcomes and enhance comparability between studies. This variability has also been seen in distinct shoulder pathologies.

For rotator cuff pathology, CMS, ASES, and VAS are the most commonly reported PROs.[31] Ashton et al found a statistically significant association between ASES use and rotator cuff pathology ($P = .001$).[4] These, however, are not disease-specific as they have been used for arthroplasty and impingement as well.[2,18,31] Disease specific scores such as the WOSI have been developed for shoulder instability. Currently, there are no available outcome measures specific to MRCT. For MCRT, as seen in our study, CMS and ASES are most consistently used.[31] The CMS is endorsed by the European Society for Surgery of the Shoulder and the Elbow[2,4,18] but considered best for assessing subacromial pathology.[42] A drawback to this tool is the variability in strength reporting. The ASES, largely used in the United States, is endorsed by the ASES committee and considered the best functional outcome score overall, regardless of pathology, to evaluate for function at a particular point in time.[2,4]

Globally, the availability of surgical care can differ as a result of healthcare disparities. These disadvantages are seen in low-income countries where surgical materials, staff, and hospital space are lacking.[1] In sub-Saharan Africa, 90% of the population has access to 1 operating room per 100,000 people. Of those available, 70% lack basic medical equipment such as a pulse oximeter.[16] Patients in low-income countries pay out of pocket to expedite surgery. Combined with cultural differences, these disparities may explain differences between countries and surgical access. According to an analysis of 196 countries stratified by the World Bank income classification, Alkire et al measured the proportion of people lacking surgical access in a modeling study.[1] They found that 97.7% and 92.3% of the population of low-income and lower-middle-income

Table III
Patient-reported outcome tool usage by region.

PRO used by region														
	ASES	CMS	CMS (a)	Quick DASH	DASH	SANE	Spadi	OSS	SST	VAS	WORC	UCLA	JOA	SSV
Asia (n = 12)	10	9		1	1		1		1	9		7	1	1
Europe (n = 16)	3	15	3	1	1		1	1		6		1		5
Middle East (n = 2)	2	2								2	1			
North America (n = 7)	4				1					2	2	3		1

PRO, patient reported outcome; *ASES*, American Shoulder and Elbow Surgeons; *CMS*, Constant-Murley Score; *CMS (a)*, absolute Constant-Murley Score; *Quick DASH*; Quick disabilities of the arm shoulder and hand; *DASH*, disabilities of the arm shoulder and hand score; *SANE*, single assessment numeric evaluation; *OSS*, Oxford Shoulder Score; *SST*, simple shoulder test; *VAS*, visual analog scale; *WORC*, Western Ontario Rotator Cuff index; *UCLA*, University of California Los Angeles, *JOA*, Japanese Orthopedic Association; *SSV*, subjective shoulder value; *SPADI*, shoulder pain and disability index.

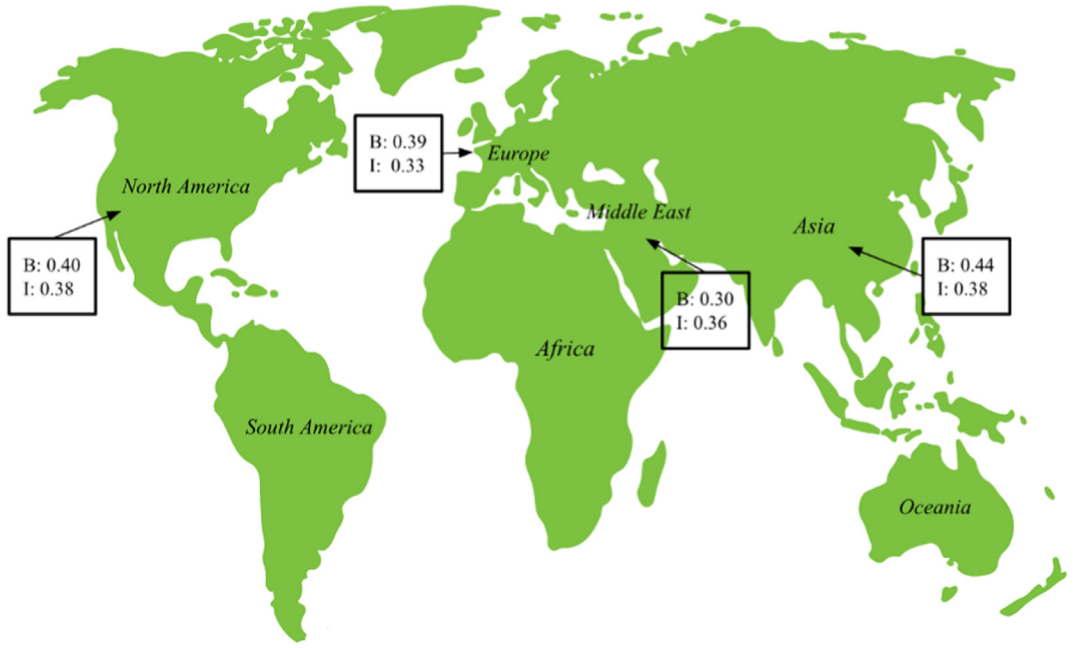

Figure 2 World regions with normalized baseline and improvement scores for arthroscopic repair of massive rotator cuff tears. *B*, baseline; *I*, improvement.

Table IV
Normalized baseline scores by region.

Baseline normalized value by region	
Asia	0.44
Europe	0.39
Middle East	0.30
North America	0.40

Table V
Normalized improvement (pre- to postoperative change) scores by region.

Improvement normalized value by region	
Asia	0.38
Europe	0.33
Middle East	0.36
North America	0.38

countries lacked access compared to 14.9% in high-income countries which included countries in Western Europe, North America, and East Asia. According to this current study, surgical tipping points were similar between these regions, which was expected, given similar access to surgery. However, preoperative scores were lower in the Middle East, which may suggest less access to care in that region. Alternatively, the lower values may be due to cultural differences in the perception of function. Nonetheless, it is interesting to note that magnitudes of improvements were similar between regions.

This systematic review has several limitations. The study selection was limited to the MEDLINE database which poses the risk of missed studies. Of the studies acquired for full-text review, there were various PROs reported, as such, there was no standardized PROs score to facilitate analysis. Some studies did not report a specific world region or country or were conducted in multiple sites and the quantity of articles was not distributed equitably by region which complicates the generalization of results. Certain regions are underrepresented in the literature, like Africa and South America, which complicates analysis of these regions, and only 2 articles were available from the Middle East. Lack of data may stem from limited surgical access combined with insufficient research funds. Language also factors into the scarcity of study availability as seen with South American articles where a high proportion of the excluded articles were written in Spanish or Portuguese. Another limitation was the scarcity and incomplete statistical data in each study including but not limited to underreporting of standard deviation or confidence intervals. Similarities were inferred upon descriptive statistics alone.

Words like comparable or similar were used as terms to describe near-identical results but not to imply *P* values above significant thresholds (eg, $P > .05$). Therefore, the limitations of this study were linked to the limitations in the assessed studies which is an inherent limitation to this type of study design (ie, systematic review). Further studies are needed to standardize PROs between regions and countries to compare surgical thresholds.

Conclusion

There is no standardized method to report outcomes in patients undergoing ARCR for MRCT. Great variation in usage exists in PROs which complicates data comparison between world regions. With normalization, baseline scores were similar between Asia, North America, and Europe, and lowest in the Middle East.

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