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Contents lists available at ScienceDirect

## The Journal of Arthroplasty

journal homepage: [www.arthroplastyjournal.org](http://www.arthroplastyjournal.org)

## Review Article

## The Use of Scoring Systems in Knee Arthroplasty: A Systematic Review of the Literature

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## ARTICLE INFO

## Article history:

Received 26 January 2016

Received in revised form

20 May 2016

Accepted 24 May 2016

Available online xxx

## Keywords:

knee arthroplasty

knee replacement

scoring system

score

patient-reported outcome measure

questionnaire

## ABSTRACT

**Background:** The primary purpose of this systematic review was to clarify and quantify scoring system utilization in knee arthroplasty literature. In addition, the study considered the frequency and relationship of score use in articles published across a range of orthopedic journals, and the influence of study design, level of evidence, primary research topic, and study country of origin on the scoring system used.

**Methods:** A systematic search of 8 electronic databases was performed to identify publications of clinical studies involving knee arthroplasty, in which a scoring system was used to assess patient outcomes.

**Results:** Of the 1994 unique publications identified, 438 met the selection criteria. Identified articles reported a total of 86 scoring systems, 5 of which were reported in greater than 10.0% of included studies. The 1989 Knee Society Score was markedly the most utilized scoring system (58.7%). Use of the Knee Society Score was significantly associated with orthopedic journal impact factor (IF;  $P = .001$ ), with greater use observed in journals of lower IF. Use of the Western Ontario and McMaster Universities Osteoarthritis Index escalated with increasing IF; however, no statistically significant association was observed. A preference for scoring systems developed in the country of residence of the first author was also identified.

**Conclusions:** A large number of scoring systems are used to assess knee arthroplasty patients; however, 5 scores are consistently reported. By identifying and quantifying scoring system use, this review hopes to stimulate regularity in score usage to allow for improvements in comparability of clinician and patient-reported outcome measures in the knee arthroplasty literature.

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Knee arthroplasty is an increasingly common surgical intervention used to alleviate pain and physical dysfunction associated with end-stage degenerative joint disease [1]. Advances in prosthesis design and surgical techniques have been accompanied by an increase in research, and the proliferation of scoring systems aimed to assess patient outcomes after knee arthroplasty.

Traditionally, outcomes of knee arthroplasty were defined objectively by prosthesis survivorship, complications, or clinician-based assessments [2,3]. More recently, there has been an emphasis on patients' perception of surgical success and consequently increased development of patient-reported outcome measures (PROMs) [3]. Limits of both clinician-administered and PROMs have been recognized, highlighting the importance of both objective and subjective assessments of the knee after surgery [3,4].

Typically, scoring systems assess a range of outcomes including pain levels, function, patient satisfaction, activity levels, overall health, and psychological state. Depending on focus, scoring systems have also been classified as disease specific, joint (knee) specific, and generic health measures [5,6]. When evaluating

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to <http://dx.doi.org/10.1016/j.arth.2016.05.055>.

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<http://dx.doi.org/10.1016/j.arth.2016.05.055>

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patient outcomes after surgery, the inclusion of both specific and generic measures has been advised [5].

A plethora of scoring systems of varying degrees of validity, reliability, translatability, and responsiveness are currently reported in the knee arthroplasty literature [2,7]. The abundance of scoring systems available has led to considerable variations in score utilization [7,8].

Lack of consensus in score usage compromises the ability to generalize results of new research to historical controls and research addressing similar constructs [9]. Qualities of different prostheses, surgical interventions, and nonsurgical factors in knee arthroplasty are difficult to compare meaningfully when diverse outcome measures, administration schedules, and levels of follow-up have been employed.

To address variations in score usage, we must first quantify current trends. Existing reviews have either summarized scoring systems available or tested the psychometric properties of a select few [9]. Dowsey et al reviewed the strengths and weaknesses of 4 knee-specific scoring systems, whereas Davies reported a summary of 10 scores available for assessment after total knee arthroplasty (TKA) [7,10]. Riddle et al [8] identified outcome measures systematically; however, only those used in randomized knee trials of  $\geq 6$ -week follow-up were included. A systematic review by Drake et al [11] assessed the use of all outcomes measured across the orthopedic knee literature; however, the review was limited to publications between 1972 and 1992.

Continued growth in score development highlights the need for a systematic review of the knee arthroplasty literature, which is inclusive of all scoring systems in use, devoid of study design limits, and with consideration of additional factors motivating score choice. Such information is not currently available in the orthopedic literature.

A recent publication concluded that orthopedic journals of higher impact factor (IF) were more likely to publish articles of level I or II evidence [12]. Such articles are, in theory, of higher value as the findings presented are based on a more rigorous study design. This raises whether similar effects have also been extended to score use, for example, whether particular scoring systems were favored in different research designs. Similarly, it brings into question whether the scoring system of choice was influenced by target journal, or inversely, whether the score chosen affected journal publication.

Variations in outcome measures have been observed across different research topics. Riddle et al [8] identified discrepancies in scores used in randomized trials assessing surgical and nonsurgical interventions for knee arthroplasty. Knowledge of which scores are being used for specific topics is necessary to achieve consistency across score usage. Further study into which scores are used to measure specific operative and nonoperative research topics would also allow for more meaningful comparisons to historical controls.

By exploring the range of factors that may influence score choice, we aimed to not only increase awareness of available scores but also motivate for greater uniformity in assessment tools chosen in future research to allow for more meaningful comparisons between studies and over time.

The primary objective of this systematic review was to *quantify scoring system utilization by frequency of use, in the knee arthroplasty literature*. In addition, we aimed to assess auxiliary factors that may influence the choice of score. The secondary objective was to *identify associations between scoring system utilization and IF of orthopedic journals, study designs, levels of evidence (LOE), study research topics, and study country of origin*.

## Materials and Methods

The protocol for this systematic review was registered on PROSPERO (registration number CRD42014014775) and performed

on the basis of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [13].

### Search Strategy

A systematic search of 8 electronic databases was performed on December 19 and 20, 2013. Databases searched included: OvidSP Medline, PubMed, CINAHL, Embase, Cochrane Library, Scopus, PEDro, and Web of Science. The search strategy was created in collaboration with a senior medical librarian and first applied to the OvidSP Medline database (see Appendix A). The search was limited to studies in humans, articles written in English, and published in 2013. Gray literature was not sought as unpublished clinical trials were ineligible for inclusion.

### Eligibility and/or Selection Criteria

Two authors selected the publications for inclusion in the review. Eligibility for inclusion was based on reviews of the title, abstract, and when indicated, a review of the full text. Publications were selected in accordance with the following criteria: (1) published clinical study involving knee arthroplasty; (2) an LOE-I, II, III, IV, or V; (3) 2013 online or journal publication date; and (4) a scoring system was used to assess the patient pre- or post-knee arthroplasty. Single Likert scales alone were not considered sufficient for classification as a scoring system; however, scale use was documented when measured in conjunction with a scoring system(s). Publications excluded were non-English articles, review articles, score or methodology validation studies, and conference abstracts. Any disagreement between authors was further deliberated until consensus was reached.

### Quality Assessment

LOE was used to rank study quality. A critical appraisal was not undertaken as score use in publications of all qualities was of interest, and outcome data were not extracted for further analysis and interpretation.

LOE for each publication was assigned in accordance with criteria outlined by *The Journal of Bone and Joint Surgery (American Volume)* (JBJS-A) [14]. In circumstances where the LOE was previously assigned, an author reassessed, and where necessary, reassigned the LOE to ensure consistency across publications included in the review.

### Data Extraction

A single author independently extracted the data from eligible publications on a standardized electronic spreadsheet. Data extracted included publishing journal, LOE, study type, study design, and scoring system. Subscores were identified as individual scoring systems and did not contribute to the use frequency of the complete scoring system. Revised and short-form scores also were considered as unique scoring systems.

Study design was classified in accordance with JBJS-A LOE hierarchy [14]. Although not specified in the JBJS-A guidelines, case report study designs were classified as LOE Level 5. The country of origin of the first author and the primary research topic of each article were also collected. Research topics were categorized under operative and nonoperative areas such as surgical technique or rehabilitation (see Appendix A).

Journal IFs were sourced from the 2013 *Journal Citation Report (JCR)* ISI Web of Science [15]. IF, first described by Dr Eugene Garfield [16], is the average frequency with which an article from

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