IKDC or KOOS? Which Measures Symptoms and Disabilities Most Important to Postoperative Articular Cartilage Repair Patients?

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Background: The relevance of knee-specific subjective measures of outcome to patients has not been evaluated for cartilage repair procedures.

Purpose: The aim of this study was to identify which instrument out of the Knee injury Osteoarthritis Outcome Score and the International Knee Documentation Committee Subjective Knee Form measures symptoms and disabilities most important to postoperative articular cartilage repair patients.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: Data were collected from 58 participants of an Internet knee forum via a self-reported online questionnaire consisting of demographic and surgical data, the Tegner activity scale, and 49 consolidated items from the Knee injury Osteoarthritis Outcome Score and the International Knee Documentation Committee Subjective Knee Form. Item importance, frequency, and frequency-importance product were calculated.

Results: Overall, the International Knee Documentation Committee Subjective Knee Form was the highest scoring instrument in all categories. However, 2 of the Knee injury Osteoarthritis Outcome Score subscales ("function in sport and recreation" and "knee-related quality of life") scored higher on mean importance and frequency-importance product than the overall International Knee Documentation Committee Subjective Knee Form score.

Conclusion: The International Knee Documentation Committee Subjective Knee Form provided the best overall measure of symptoms and disabilities that are most important to this population of postoperative articular cartilage repair patients. This brings into question the validity of using the Knee injury Osteoarthritis Outcome Score in shorter-term—less than 10 years—studies. Issues related to sports activity appear to be highly valued and very pertinent to evaluation of outcomes for this patient group.

Keywords: IKDC; KOOS; knee outcome measures; cartilage repair

Thousands of people each year experience symptoms related to chondral defects of the knee that often threaten quality of life (QOL), especially in an active population.[11,45] It is well established that chondral defects have a low intrinsic capacity for repair, but surgical options are now available to many of these patients where previously the only option was arthroplasty.[2,49,65]

Health-related QOL measures have become vital in the implementation of evidence-based practice.[62] Quality of life in clinical medicine has been defined as "representing the functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient."[63(p16)] The concerns and viewpoint of the patient are thus an integral component in the measurement of QOL.

Patient-based measures of outcome have increased exponentially during the last 20 years and are now often used as primary and secondary measures of a treatment's effect.[10,20] The field of articular cartilage repair (ACR) is no exception, and instruments to measure patient-reported outcome are gaining increasing popularity for the evaluation of surgical procedures to repair chondral defects. However, the choice of instrument or instruments is not straightforward or clear

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TABLE 1
Results for IKDC and KOOS Items From Tanner et al[68,a]

	Endorsed by at Least 51% of Patients			Number of Items With Mean Importance Ranking of at Least 3			Number of Items With Mean Importance Ranking of 1 or Less		
Instrument	ACL	Meniscal	OA	ACL	Meniscal	OA	ACL	Meniscal	OA
IKDC (18 items)	13 (72%)	18 (100%)	18 (100%)	2	2	4	6	2	2
KOOS (42 Items)	19 (45%)	36 (86%)	38 (90%)	1	5	14	9	14	3

[a]IKDC, International Knee Documentation Committee; KOOS, Knee injury and Osteoarthritis Outcome Score; ACL, anterior cruciate ligament; OA, osteoarthritis.

cut.[19] It was commented in a *Journal of Bone and Joint Surgery* editorial that "there are almost as many sets of questions asked as there are papers published."[3(p1583)] The author went on to state that it is important to determine whether the questions address an issue of importance to the patient and whether the item has been weighted according to its importance to the patient.[3]

Any questionnaire used as a primary measure of outcome must reflect areas that are important to patients suffering from the specific disease or condition.[23] This necessitates incorporation of the patient's perspective of outcome in the evaluation of the impact that ACR surgery has on an individual.[20,21] There is currently no agreement regarding a gold standard patient-assessed measure of the effects of cartilage repair surgery. The comparative evaluation of patient-assessed health instruments for the knee has been recommended,[21] and investigators are being urged to consider matching an instrument to the specific purpose of the study.[19]

The diversity in the number of patient-based measures of outcome used in orthopaedics presents a major methodological issue when analyzing outcomes from published studies on ACR.[21,34,70] Patient-based measures of outcome can be categorized as being generic, disease-specific, population-specific, or site-specific.[19,20] Site-specific instruments are described as containing items that are particularly relevant to patients experiencing treatment for a very specific region of the body.[19] The use of site-specific measures has the proposed advantage that the items in the instrument should be more relevant to a patient group experiencing treatment for the specific region.[19] At present there are no disease-specific instruments for chondral defects, and therefore ACR studies generally use knee-specific instruments. It has been recommended that outcome measures should be validated for use specifically on patients with cartilage injuries.[34]

In 2007, Tanner et al published the first study to compare the ability of knee-specific QOL instruments to detect symptoms and disabilities that are important to patients.[68] The authors consolidated the subjective portion of 11 knee-specific instruments and assessed the frequency and importance of each item. A mixed sample of 153 patients with ACL rupture, isolated meniscal tears, and osteoarthritis were recruited. Both preoperative and postoperative patients were sampled, but the average postoperative times were not detailed, nor were these analyzed as subgroups. The Tanner et al results for Knee injury Osteoarthritis Outcome Score (KOOS) and International Knee Documentation Committee Subjective Knee Form (IKDC) are summarized in Table 1. The authors concluded that out of the general knee instruments studied, the IKDC and the KOOS contained the most items important to patients in their population group.

Clearly research trials should use a validated questionnaire that is specific for the condition being studied.[62] There is a need to establish whether the commonly used knee-specific patient-based measures of outcome are relevant to the actual complaints of patients who undergo cartilage repair procedures. The aim of this study is to identify which instrument out of KOOS and IKDC measures symptoms and disabilities most important to postoperative ACR patients.

It is hypothesized that because chondral defects have been shown to play an integral role in the pathogenesis of osteoarthritis[17,44,49,73] the KOOS will provide a better measure of symptoms and disabilities that are most important to postoperative ACR patients. The scores for both KOOS and IKDC were expected to demonstrate an inverse relationship with postoperative time and a positive relationship with age at time of surgery.

METHODS

The Instruments

Two of the most commonly used patient-based measures of outcome in articular cartilage repair are the IKDC[30] and the KOOS.[58] These 2 instruments are both site-specific measures that have been developed to assess health and QOL of patients with a knee problem. The IKDC has been used in clinical studies on autologous chondrocyte implantation (ACI),[§] osteochondral plugs,[12,15,16,39] and microfracture.[13,22,46] The KOOS has been used in clinical studies on ACI,[7,43,49,53,54,74] osteochondral plugs,[39] and microfracture.[13] Several of the studies used both IKDC and KOOS, but no comparative evaluations were made between the 2 instruments.[7,39,49,53]

International Knee Documentation Committee Subjective Knee Form (IKDC). The IKDC is a site-specific instrument designed to measure symptoms, function, and sports activity in patients who have one or more of a variety of knee conditions, including ligament, meniscal, articular cartilage, arthritis, and patellofemoral injuries.[30] The original

[§]References 7, 16, 26, 27, 42, 46-49, 53, 61, 64, 71, 74.

instrument was developed by an international committee in 1987,[29] and the Subjective Knee Form was subsequently added in 2000.[30]

The instrument consists of 18 items related to symptoms, function, and sports activity and is able to differentiate patients with greater knee symptoms and lower levels of function.[4] The IKDC is scored by calculating the difference between the raw score and lowest possible score and then dividing this difference by the range of possible scores multiplied by 100. Higher scores denote greater levels of function and lower knee symptoms. This method of scoring weighs each item according to the number of response options.

Normative data have been established for the US population for age and gender.[4] Women have been found to exhibit lower mean scores than men. It has been recommended that studies with patients less than 18 years or 35 years and older should adjust the Subjective Knee Form scores for age difference for both men and women.[4] The IKDC has been shown to have an internal consistency of 0.92 and a test-retest correlation of 0.94.[21] The overall IKDC score has also been shown to demonstrate acceptable psychometric performance for outcome measures of meniscus injuries of the knee.[14]

Knee injury and Osteoarthritis Outcome Score (KOOS). The KOOS is a site-specific instrument that was developed with the purpose of evaluating short-term and long-term symptoms and function in subjects with a variety of knee injuries that could possibly result in osteoarthritis.[55,58,59] The instrument is based on an extension of the disease-specific Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index.[5] The KOOS comprises 42 items containing 5 separately scored subscales: pain (9), other symptoms (7), activity in daily living (ADL) (17), function in sport and recreation (Sport/Rec) (5), and knee-related QOL (4).[56] In contrast to the IKDC, in which the items are summed to produce a single index, the KOOS has separate scores for different health dimensions, with higher scores signifying worse functioning in these areas. Importantly, the KOOS is one of the few patient-assessed knee-specific instruments where patients have been involved in the derivation of the items.[21]

The KOOS has been validated for several orthopaedic interventions, including total knee replacement,[59] meniscectomy,[57] and ACL reconstruction.[58] Population-based reference data for age and gender in an adult population has been established.[50] The KOOS has been shown to have an internal consistency between 0.71 and 0.95[57] and a test-retest correlation of 0.75 to 0.93.[58]

The Tegner activity scale. The Tegner activity scale was designed as a score of activity level to complement the functional score of the Lysholm knee score for patients with ligamentous injuries.[69] The instrument scores a person's activity level between 0 and 10 where 0 is "on sick leave/disability" and 10 is "participation in competitive sports such as soccer at a national or international elite level." It is the most widely used activity scoring system for patients with knee disorders.[8] The psychometric properties have been analyzed for patellar dislocation outcomes[52] and meniscal lesions[8] and have demonstrated, in general, acceptable psychometric parameters. However, the Tegner activity scale has not been independently, separately validated[35] or psychometrically assessed specifically for ACR outcomes.

Demographic Data

The demographic data used to describe the study cohort were self-reported date of birth and gender.

Surgical Data

Surgical data were composed of self-reported responses for type of cartilage repair surgery, location of areas that were repaired (including multiple), month and year of cartilage repair surgery, and concomitant procedures.

Development of the Study Questionnaire

The online questionnaire was developed as per the methodology of Tanner et al[68] using the questionnaire activity module (version 2005062701) of Moodle (version 1.5.3). Moodle is an open source software package designed using pedagogical principles to help educators create effective online learning communities (http://moodle.org). The questionnaire activity module is based on Hypertext Preprocessor Easy Survey Package (phpESP) and is a tool to create surveys. The responses from the questionnaire were stored anonymously using numeric reference ID numbers and exported as comma-separated value files for analysis.

A questionnaire of 57 items was developed that included 7 items related to demographic and surgical information; 49 items were consolidated from the IKDC and the KOOS (7 items from IKDC; 31 items from KOOS; and 11 items in both KOOS and IKDC, ie, item overlap) and the Tegner activity scale. To compare results from this study with the Tanner study it was necessary to make some modifications to items from the IKDC and KOOS instruments. In line with the Tanner study, double-barrelled items were separated into 2 items, and questions on the IKDC were changed to the present tense rather than the standard "during the past 4 weeks."

Participants were asked to rate the importance of a described symptom or disability using a 6-point Likert scale as shown in Figure 1. The final questionnaire was pretested in a small sample of noncartilage knee repair patients and orthopaedic colleagues for explanation of purpose, clarity of questions, and ease of completion before it was transferred to an online environment.

Participant Recruitment

The focus of this study was to assess which instrument best measured symptoms and disabilities important to ACR patients and not the effectiveness of any one surgical procedure. Within this context, the inclusion criteria for participation was an individual who had undergone ACR of the knee rather than a specific surgical repair procedure. The

Sample Question: Knee is painful.					
Not experienced	Experienced but not important	Experienced and a little important	Experienced and moderately important	Experienced and very important	Experienced and extremely important
0	1	2	3	4	5

Figure 1. Sample question and Likert Scale used in the study questionnaire.

study was approved by the London Metropolitan University's ethics committee as part of a larger PhD research study.

Participants were recruited from the KNEEguru Web site (http://www.kneeguru.co.uk). The KNEEguru site is a resource for people with knee problems and has more than 20 000 registered members from across the world. The Web site is based around a dynamic bulletin board to which individuals older than 18 years must register to interact. Potential subjects were invited to participate in the study via postings in relevant topic areas on the KNEEguru bulletin board. The purpose and aims of the study and the role of the participants were included in the invitation as per established guidelines for online research.[9,18] Self-registration to the study and self-submission of the questionnaire was taken as consent to participate.[67] Data collection took place during a period of 6 months between July 2007 and January 2008. Access to the questionnaire was via a URL link, and participants were either able to use their existing bulletin board login details or a generic account set up specifically for the survey. Data were only saved to a secure server if participants chose to submit the questionnaire. Stored data for each submitted questionnaire was linked to a unique response identification number.

Data Analysis

All data collected via the online questionnaire were imported into a customized database. Statistical analysis was performed with SPSS for Windows 14.5 software (SPSS Inc, Chicago, Ill). Nonparametric analyses were selected based on the data not being normally distributed and the data categories being predominantly in ordinal format.

The data were summarized using descriptive statistics. Medians and ranges were calculated for ordinal data, but means and standard deviations (SD) were also calculated to make comparisons with previous research[68] as per published recommendation.[40] A series of correlations were carried out using Spearman's ρ to identify any potential relationships between demographic factors and items ratings. The Mann-Whitney *U* test and Kruskal-Wallis test were used to compare data between participant subgroups based on age and time elapsed since ACR. Significance levels were set at $P < .05$.

Two postoperative time categories were established comprising participants who were less than a year after ACR surgery and those who were a year or more. A year was chosen as the break point for the subgroups based on the surgical and rehabilitation recovery timescales.[24,25] The participants were also grouped into 2 age categories: <35 years and ≥35 years. These age categories were chosen based on the finding that age differences in IKDC scores started to emerge at 35 years of age[4] and that an age greater than 35 years has been shown to be a negative predictor of outcome.[66]

In accordance with Tanner et al[68] and prior recommendations for the development of QOL questionnaires, a clinical impact methodology was adopted.[23,36] The item frequency was recorded as the number of patients who listed the item as a problem (maximum 58). The importance ranking was recorded as the value of each item on a Likert scale from 0 to 5 where 0 was "not experienced" and 5 was "experienced and extremely important." The individual patient ranking (IPR) was calculated as the average ranking of items for each patient. The mean importance ranking (MIR) was recorded as the mean ranking of importance for each item. The clinical impact was expressed as the frequency importance product (FIP) where the MIR was multiplied by the proportion of patients experiencing a particular item.[36] It is important to report the MIR alongside the FIP, as they represent different constructs. The MIR indicates the average importance across all patients, including those patients who did not experience a particular item and provides an overall profile of the population. The FIP takes into account that some patients may not have experienced an item, and it therefore provides a more accurate indicator of the clinical impact an item has on a patient who experiences that particular item. A high FIP is an advantage for a health-related QOL measure as it is an indication that not only is an item frequently experienced but also that it is an important symptom or disability for patients.

In addition to the overall MIR and FIP for each item in the 2 instruments, the MIR and FIP ratings across the items corresponding to the 5 separate KOOS subscales were also calculated. These summary ratings served as indices of the relevance and importance of the subscales in the populations: how the particular subscale rather than individual items were perceived and evaluated by respondents. This was not performed for IKDC as the measure yields one overall score.[30]

In accordance with Tanner et al,[68] calculations were also made for:

- The number of items that at least 51% of the patients rated with a value of at least 1 (experienced but not important) on the Likert scale.
- The number of items that had an MIR of at least 3 (experienced and moderately important) on the Likert scale.
- The number of items that had an MIR of 1 (experienced but not important) or less on the Likert scale.
- The number of items that had an FIP of at least 3.
- The number of items that had an FIP of 1 or less.

RESULTS

The online survey was completed by 58 participants. Data collection was complete except for 9 participants who incorrectly entered their date of birth. The mean age of

participants at the time of surgery was 35.5 years (SD, 7.7; range, 23-49 years) and the Tegner activity scale mean score was 2.93 (median, 2.5; range, 0-10). The most common ACR surgical procedure was a marrow-stimulating technique (45%), followed by cell-based repair (31%), and osteochondral plugs (19%). More than a quarter of the ACRs were multiple sites (28%), with the most frequent isolated repair areas reported as being medial femoral condyle (28%), patella (19%), and lateral femoral condyle (17%). Overall, 60% of patients underwent a concomitant surgical procedure.

Table 2 displays the MIRs, frequencies, and FIPs for each item, and Table 3 displays the overall MIRs, frequencies, and FIPs for each of the 2 instruments. Average item MIR was 2.81 for the IKDC (SD, 0.72) and 2.31 for the KOOS (SD, 0.84). The IPR for the KOOS and the IKDC were significantly correlated ($\rho = .944$; $P < .01$). Evaluation of the 2 measures on the 5 set criteria indicates that the IKDC outperformed the KOOS on frequencies, MIR, and FIP ratings.

The study cohort comprised 31 women (mean age at time of surgery, 36.3 years; SD, 7.4; range, 23-49 years) and 27 men (mean age at time of surgery, 34.6 years; SD, 8.2; range, 21-48 years). There was no significant difference in age at time of surgery between men and women ($P = .478$). A statistically significant difference ($P = .042$; $P < .05$) was found in time from surgery between men (13.3 months) and women (27.4 months). However, there were no significant correlations between time from surgery and any of the item ratings for the women. The importance rating for the item "knee is swollen" was significantly negatively correlated to the time from surgery for the men ($\rho = .406$; $P < .05$). Male gender was significantly associated with a higher Tegner activity scale score ($P < .05$). Table 2 indicates the items where significant differences in importance ratings were found between men and women.

KOOS

Inspection of ratings for KOOS individual items showed that the item "modified lifestyle to avoid activities that are potentially damaging to knee" exhibited the highest ratings (MIR = 4.00; FIP = 3.86). At the other end of the scale, the KOOS item "can't straighten knee" exhibited the lowest ratings (MIR = 1.10; FIP = 0.38). The 3 KOOS items that were not experienced by at least half of the study group were "can't straighten knee," "lying hurts," and "sitting difficult."

When the KOOS results were split into the 5 subscales as shown in Table 4, it was evident that ADL was neither viewed as being particularly important by this patient cohort (ADL-MIR = 1.86) nor was it frequently experienced (ADL-FIP = 1.32). In contrast, the subscales of function in sports/recreation and knee-related QOL were viewed as being more important than pain, other symptoms, and ADL subscales (Sports/Rec MIR = 3.44; QOL-MIR = 3.72) and were more frequently experienced (Sports/Rec FIP = 3.09; QOL-FIP = 3.57). Many items in the KOOS, despite being experienced, exhibited a low MIR, with 24% (10/42) of the items exhibiting an FIP of 1 or less. These 10 items were in the pain (3), other symptoms (1), and ADL (6) subscales. None of the items in the function in sports/recreation or knee-related QOL subscales had an FIP of 1 or less.

Group comparisons between male (n = 27; mean KOOS item score, 2.01; SD, 1.21) and female (n = 31; mean KOOS item score, 2.58; SD, 1.19) patients indicated that female respondents reported significantly higher KOOS item importance ratings relative to their male counterparts ($P = .049$; $P < .05$, respectively). There were no significant differences in MIR and FIP between male and female subjects for the subscales of function in sports/recreation and knee-related QOL, but the female subjects did score significantly higher MIRs and FIPs for the pain and ADL subscales and MIR for other symptoms (see Table 4).

Inverse correlations were noted between Tegner and KOOS IPR, indicating the lower the Tegner score, the greater the level of experience and importance of the symptoms and disabilities evaluated in the KOOS ($P < .01$). There were no statistically significant associations between KOOS IPR and postoperative time ($P = .942$) or age at surgery ($P = .487$).

IKDC

Mean importance rankings and FIPs (Table 2) indicated that the majority of the IKDC items were both frequently experienced and perceived to be important. Of the 18 items in the questionnaire, the item "difficult to participate in strenuous activities" received the highest MIR rating (3.71), and the item "running difficult" received the highest FIP rating (3.29). The item that scored lowest for both MIR (1.21) and FIP (0.60) was "sitting difficult." In addition, "sitting difficult" was the only IKDC item that was not experienced by at least half of the study group. The IKDC contained 4 items that were not experienced by at least 76% of the participants. Those items were "sitting difficult" with participant frequencies of experience of 50% (29 of 58); "knee locks, catches, or hangs up when moving" with 69% (40 of 58); "swelling limits strenuous activities" 67% (39 of 58); and "giving way limits strenuous activities" with 69% (40 of 58).

Group comparisons between male (n = 27; mean IKDC item score, 2.57; SD, 1.24) and female (n = 31; mean IKDC item score, 3.02; SD, 1.31) patients indicated that female respondents did not report significantly higher MIR or FIP relative to their male counterparts (see Table 4).

A higher Tegner activity scale score was significantly associated with a lower IPR for IKDC ($P < .01$). There were no statistically significant associations between IKDC IPR and postoperative time ($P = .889$) or age at surgery ($P = .304$).

DISCUSSION

In the new era of medical research, patients' outcomes other than morbidity and mortality now provide a significant contribution to the discussion and evaluation of most surgical interventions. In ACR research, a 1:1 correspondence between objective indices of procedural success (eg, histology, arthroscopic indentation, or MRI), and patients' symptomatology and functional capacity has not been

TABLE 2
Mean Importance Ranking, Item Frequency of Experience, and Clinical Impact (FIP) for Each Item[a]

Item Description	Instrument	Mean Importance Ranking (median; range)	Item Frequency of Experience (max 58)	Clinical Impact (FIP)
Knee is painful	IKDC & KOOS	3.33 (4.0; 0-5)	55	3.16
Knee is stiff	IKDC	2.50 (2.5; 0-5)	48	2.07
Knee is swollen[b]	IKDC & KOOS	2.02 (2.0; 0-5)	44	1.53
Knee stiff after first waking in morning[b]	KOOS	2.00 (2.0; 0-5)	42	1.45
Knee stiff after sitting, lying, or resting later in the day[b]	KOOS	2.34 (3.0; 0-5)	46	1.86
Knee locks, catches, or hangs up when moving[b]	IKDC & KOOS	2.16 (2.0; 0-5)	40	1.49
Knee grinds, grates, or clicks when knee moves	KOOS	2.59 (3.0; 0-5)	51	2.27
Can't straighten knee fully	KOOS	1.10 (0; 0-5)	20	0.38
Can't bend knee fully	KOOS	1.83 (1.0; 0-5)	35	1.10
Twisting/pivoting on knee is painful	KOOS	2.95 (4.0; 0-5)	46	2.34
Straightening knee fully hurts	KOOS	1.52 (1.0; 0-5)	33	0.86
Bending knee fully hurts	KOOS	1.84 (1.0; 0-5)	38	1.21
Walking on a flat surface hurts[b]	KOOS	1.79 (1.0; 0-5)	36	1.11
Going up stairs hurts[b]	KOOS	2.72 (3.0; 0-5)	48	2.25
Going down stairs hurts[b]	KOOS	2.72 (3.0; 0-5)	48	2.25
Knee hurts at night when in bed[b]	KOOS	1.95 (2.0; 0-5)	40	1.34
Sitting hurts	KOOS	1.48 (1.0; 0-5)	31	0.79
Lying hurts[c]	KOOS	1.33 (1.0; 0-5)	29	0.69
Standing hurts	KOOS	2.02 (2.0; 0-5)	40	1.39
Going down stairs is difficult[b]	IKDC & KOOS	2.71 (3.0; 0-5)	46	2.15
Going up stairs is difficult	IKDC & KOOS	2.79 (3.0; 0-5)	48	2.31
Rising from sitting is difficult	IKDC & KOOS	2.28 (2.0; 0-5)	47	1.84
Standing is difficult	KOOS	1.93 (1.5; 0-5)	40	1.33
Bending to the floor is difficult	KOOS	2.45 (2.0; 0-5)	40	1.69
Walking on a flat surface is difficult	KOOS	1.67 (1.0; 0-5)	35	1.01
Getting in/out of car is difficult	KOOS	1.84 (2.0; 0-5)	42	1.34
Going shopping is difficult[b]	KOOS	1.83 (2.0; 0-5)	40	1.26
Putting on and taking off socks is difficult	KOOS	1.13 (1.0; 0-5)	29	0.58
Lying in bed and maintaining knee position is difficult	KOOS	1.26 (1.0; 0-4)	32	0.69
Getting in/out of bath is difficult	KOOS	1.41 (1.0; 0-5)	36	0.88
Sitting is difficult	IKDC & KOOS	1.21 (0.5; 0-5)	29	0.60
Getting on/off toilet is difficult	KOOS	1.62 (1.0; 0-5)	36	1.01
Heavy domestic duties are difficult	KOOS	2.79 (3.0; 0-5)	51	2.46
Light domestic duties are difficult	KOOS	1.57 (1.0; 0-5)	34	0.92
Squatting is difficult	IKDC & KOOS	3.19 (4.0; 0-5)	51	2.80
Running is difficult	IKDC & KOOS	3.67 (5.0; 0-5)	52	3.29
Jumping is difficult	IKDC & KOOS	3.47 (5.0; 0-5)	52	3.11
Stopping and starting quickly is difficult	IKDC	3.50 (4.0; 0-5)	52	3.14
Twisting/pivoting on knee is difficult	KOOS	3.62 (4.0; 0-5)	54	3.37
Kneeling is difficult	IKDC & KOOS	3.28 (4.0; 0-5)	51	2.88
Lack of confidence in knee	KOOS	3.71 (4.0; 0-5)	56	3.58
Often aware of knee problem	KOOS	3.79 (4.5; 0-5)	56	3.66
Modified lifestyle to avoid activities that are potentially damaging to knee	KOOS	4.00 (5.0; 0-5)	56	3.86
General difficulty with knee	KOOS	3.4 (4.0; 0-5)	54	3.16
Knee limits daily activities	IKDC	3.24 (4.0; 0-5)	50	2.79
Knee pain limits strenuous activities	IKDC	3.62 (4.0; 0-5)	51	3.18
Swelling limits strenuous activities	IKDC	2.00 (2.0; 0-5)	39	1.34
Giving way limits strenuous activities	IKDC	1.93 (1.0; 0-5)	40	1.33
Difficult to participate in strenuous activities on a regular basis	IKDC	3.71 (5.0; 0-5)	51	3.26

[a]FIP, frequency-importance product; IKDC, International Knee Documentation Committee; KOOS, Knee injury and Osteoarthritis Outcome Score.
[b]Significant difference in ratings between males and females ($P < .05$)
[c]Significant difference in ratings between males and females ($P < .01$)

TABLE 3
Results of Mean Importance Ranking, Experience Frequency, and Frequency-Importance Product for the IKDC and Overall KOOS[a]

	IKDC	KOOS
Items on instrument	18	42
Number of items with an MIR[a] of 3 or more (%)[b]	9 (50)	10 (24)
Number of items with an MIR[a] of 1 or less (%)[b]	0 (0)	0 (0)
Number of items experienced by at least 51% of patients (%)	17 (94)	38 (90)
Number of items experienced by at least 76% of patients (%)	14 (78)	20 (48)
Number of items with FIP of at least 3 (%)	6 (33)	8 (19)
Number of items with FIP of 1 or less (%)	1 (6)	10 (24)

[a]IKDC, International Knee Documentation Committee; KOOS, Knee injury and Osteoarthritis Outcome Score; MIR, mean importance ranking; FIP, frequency-importance product.
[b]Score on a Likert scale of 0 to 5, with 0 being "not experienced" and 5 being "experienced and very important."

TABLE 4
Mean MIR and Mean FIP for All Items in IKDC, Overall KOOS, and KOOS Subscales for the Total Cohort and Male and Female Subgroups[a]

	Mean MIR			Mean FIP		
Instrument	All	Male	Female	All	Male	Female
IKDC overall	2.81	2.57	3.02[b]	2.35	2.11	2.59[b]
KOOS overall	2.31	2.01	2.58[c]	1.81	1.52	2.11[c]
KOOS Subscales						
Pain	2.16	1.72	2.53[c]	1.58	1.16	2.01[c]
Other symptoms	2.00	1.57	2.39[c]	1.44	1.05	1.86[b]
Function in daily living (ADL)	1.86	1.58	2.11[c]	1.32	1.03	1.62[c]
Function in sports/recreation	3.44	3.45	3.44[b]	3.09	3.07	3.11[b]
Knee-related quality of life	3.72	3.54	3.89[b]	3.57	3.41	3.70[b]

[a]MIR, mean importance ranking; FIP, frequency-importance product; IKDC, International Knee Documentation Committee; KOOS, Knee injury and Osteoarthritis Outcome Score.
[b]No significant difference between males and females ($P < .05$).
[c]Significant difference between males and females ($P < .05$).

established. The need to consider the patient's perspective has led to the development of numerous measures and instruments to assess and quantify patients' experience and evaluation of knee functioning. Typically these measures focus on a range of symptoms and disabilities, indices of functional capacity, and performance of daily and other valued activities that are thought to be generally applicable to all patients with knee-related pathology and dysfunction. The present study was designed to examine and compare 2 of the most widely used knee-specific patient reported measures in the field, namely the IKDC and KOOS, on the extent to which they assess symptoms and disabilities that are frequently experienced and are ranked as important by patients that have undergone ACR.

Taken collectively, study findings indicate that although both questionnaires comprise items that are experienced by at least half of the respondents, their relative importance ratings vary greatly. It is of note, for instance, that knee pain was experienced by 95% of respondents, yet it was not considered to be as important as, for instance, difficulty running or participating in strenuous activities. Similarly, items associated with pain or difficulty with bending or straightening the knee were scored low, with mean FIPs ranging from 0.38 to 1.21, compared with functional activities such as items associated with going up or down stairs, which scored mean FIPs of 2.15 to 2.31. This suggests that evaluation of symptoms should be secondary to the evaluation of functional problems and performance limitations and activity restrictions, as these appear to be more important to patients.

Despite yielding similar results in terms of the psychometric properties such as internal consistency and construct validity,[4,14,21,29-33,50,56-59] evaluation of the 2 instruments on relevance and importance indices point to the IKDC as the instrument of choice for cartilage repair patients. Across all criteria, IKDC performed consistently better than KOOS. The IKDC contained more items that are both frequently experienced and considered to be important by patients. Half of the

items (n = 9; 50%) in the IKDC received an MIR of 3 or more (out of a possible 5) suggesting that on the whole, the instrument is tapping into issues that are key in determining how patients make judgments and evaluate their postoperative experience and functioning. This is a particularly intriguing finding because the IKDC was developed by experts without any direct patient input. The convergence of views among health care professionals and recipients of care is encouraging in the context of newly shared models of health care and decision making. On the other hand, this population of patients did not evaluate the KOOS items as favorably. Despite the fact that there were no KOOS items with an MIR of 1 ("experienced but not important") or less (out of a possible 5), a substantial number of items received low FIPs of 1 or less (n = 10; 24%) suggesting that the KOOS demonstrated a higher level of construct irrelevance than the IKDC. There are several plausible explanations for this finding. One reason the KOOS may have exhibited a higher number of irrelevant items is that it includes all WOMAC items and focuses on longer term consequences of osteoarthritis.[59] Additionally, the pilot study that was conducted to identify the subjectively most relevant factors and subsequently derive the items for the KOOS instrument ranged in age from 35 to 76 years (mean, 56 years) and all showed radiological signs of knee osteoarthritis.[51,56] The KOOS covers immediate consequences and also the chronic outcome in the older patient, that is, late-disease–specific symptoms of osteoarthritis. However, the natural development of osteoarthritis after knee joint injury can commonly take 10 to 15 years.[41,44,60,72] This brings into question the validity of using the KOOS in short-term studies of less than 10 years postoperative follow-up, especially as current clinical research guidelines for ACR procedures recommend a minimum of only 2 years' follow-up.

It is also important to note the divergence of patients' views regarding the importance of various KOOS domains and subscales. The majority of the items that received low FIP ratings were in the pain, other symptoms, and ADL subscales. Items in the subscales on sports and recreation such as running and jumping were both perceived to be important (MIR = 3.44 and 3.72, respectively) and were frequently experienced (FIP = 3.09 and 3.57, respectively). An opposite pattern of results has been noted in the Tanner et al[68] study, in that disabilities pertaining to participation in moderate to vigorous sports were rated the least important among osteoarthritis patients. Discrepancies in patient characteristics are likely to account for this differential pattern of results. Our study sample consisted of predominantly young adults (mean age at time of surgery, 35.5 years) compared with the osteoarthritis group in Tanner et al (mean age, 59.9 years). These differences were anticipated as children and individuals older than 55 years of age are usually excluded in ACR procedures.[1] This is consistent with the age profile—reported in years—of ACR patients in recently published studies: Horas et al[28] (mean, 33.4; range, 18-44), Knutsen et al[37] (mean, 32.2; range, 18-45), Bentley et al[6] (mean, 31.3; range, 16-49), and Kreuz et al[38] (mean, 35; range, 18-50). Patients eligible for ACR procedures therefore tend to be a younger segment of the patient population compared to the osteoarthritis patient population.

There were some pertinent differences in the results between the male and female subjects in the study population. The higher Tegner Activity Score for the male subjects was an expected outcome. The statistically significant difference in the overall KOOS ratings between men and women was unexpected. When the KOOS subscales are considered, it appears that women tend to rate several items in the pain, other symptoms, and ADL subscales higher in importance than men. However, there was a statistically significant difference in the time from surgery between male and female subjects, the potential implications of which will be discussed later. For the IKDC, although the women reported higher overall ratings, the lack of a statistically significant difference from the men may be an indication that the IKDC is influenced less by gender than the KOOS. Potential gender differences in ratings of outcome measures have important implications in the comparative analysis of clinical studies, and further research is required in this area.

The findings of the current study should be considered in light of 2 limitations. The first methodological limitation relates to the cross-sectional design of this study, which precludes inferences on the sensitivity or responsiveness of the 2 measures over time. The second methodological issue relates to the sample size and representiveness. The sampling for this study was via online self-selection from a forum for people with knee problems. In the author's experiences of working with online knee forums, it has been found that when an individual's knee problem has either been significantly reduced or eliminated, they frequently leave the forum and do not return unless they encounter a subsequent knee problem. Therefore it is proposed that as postoperative time increases, a continued active presence on a forum such as KNEEguru may be an indication of an individual experiencing higher levels of symptoms and disabilities than those people with the same postoperative time who have left the forum. This may explain why the women in this study demonstrated higher MIRs and FIPs for both instruments as, despite the genders being age-matched, there was a significant difference in the time from surgery, with men completing the survey at an average of 13 months postoperatively and the women at 27 months. If this is the case, the use of online participant recruitment through forums may mean that the results of this study cannot be generalized to the broader ACR patient population. However, these online forums are an important support mechanism for a growing number of orthopaedic patients worldwide and as such warrant evaluation in their own right.

Potential confounding variables that were not evaluated in this study included cultural differences, pain medication, body mass index, symptom duration, or compliance with rehabilitation. Conducting further studies on the broader cartilage repair population not represented in this study would be a fruitful endeavor, and recruiting even larger samples to enable effective multigroup analysis should be pursued in future research. Despite the limitations, the study findings build on previous work by Tanner et al[68] to further the case that we need to look at the relevance of knee-specific patient-reported measures in the context of the specific population under study.

In conclusion, both the IKDC Subjective Knee Form and the KOOS contained a large number of items that were experienced by, and are important to, this population of ACR patients. The study findings point to the IKDC Subjective Knee Form being the knee-specific instrument of choice for this population of ACR patients due to its overall performance compared with the KOOS.

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