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Review Article

Outcome measures used in patient with knee osteoarthritis: With special importance on functional outcome measures

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ABSTRACT

Understanding the impact of evidence-based practice toward the rehabilitation of patients with knee osteoarthritis (PKOA) is possible with appropriate outcome measures. There is a definite need to summarize the available outcomes with reference to knee OA. This review summarizes the available outcome measures used in the diagnosis, prognosis, and rehabilitation of PKOA. Electronic searches of PubMed, Medline, CINAHL, PsycINFO, Google Scholar, and EBSCO were conducted using terms relating to outcome measures used in the diagnosis, prognosis, and rehabilitation of PKOA. Papers examining the relationship between psychosocial factors and pain and disability outcomes following physiotherapy were included. Two reviewers selected, appraised and extracted studies independently.The searched papers were classified under three classifications, radiological, arthroscopic, and functional knee OA outcome measures. 26 outcome measures used in the diagnosis, prognosis, and rehabilitation of PKOA were identified. Nine outcome measures were included under radiological, four under arthroscopic and remaining 13 under functional classification. Oxford knee score and WOMAC have excellent reliability and good validity among them. In developing countries, still, we use the scales validated and available from the developed countries. This will not reflect the actual treatment effect among PKOA. This review will assist in educating orthopedician, physiotherapist, academician, and researchers on the available in the diagnosis, prognosis, and rehabilitation of PKOA. This review highlight the need for patient-reported outcome measures from the developing countries to document actual treatment effect.

Keywords: Developing countries, knee, osteoarthritis, pain, radiography

Introduction

Among the world diseases, osteoarthritis (OA) ranked fourth for the contributing factor of disability.[1] OA is chronic, slowly progressive, degenerative disease of joint which affects articular cartilage and accompanied by pain, swelling, and loss of function.[2,3] OA affects various joints such as knee, hip, ankle, wrist, cervical, and lumbar. Out of 291 conditions globally, the 11th highest contributor to global disability is hip and knee OA.[4] 22%–39% of 1.252 billion population suffer from OA in India. Hip and knee OA is the most prevalent forms of OA with the overall prevalence of knee OA is 28.7%.[5] Among them, common is knee joint affecting one in two people over 85 years of age.[6] In India, many health-care professionals treat patients with various stages of OA. However, surprisingly many of them fails to use suitable scale or outcome measure to document their gained benefits. The health care professionals should be made aware about the importance of using proper scales for documenting patient progression. Measuring results of treatment in clinical setting has been an age long practice. The outcome measure in clinical practice provides the mechanism by which the health care provider, the patient, the public, and the payer are able to assess the end results of care and its effect upon the health of the patient and society. The measurement of clinical outcomes in the health care delivery system is mandatory in clinical decision making. We can classify the scale which is used in the PKOA under three categories namely, radiological, arthroscopic and functional, Figure 1.

Information Source

The articles are searched academic databases from inception to February 23, 2018. In addition, the reference sections of the extracted articles were manually searched for any articles missed by the electronic search. Academic databases, including PubMed, Medline, CINAHL, PsycINFO, and EBSCO, were used to extract relevant studies. The primary author conducted

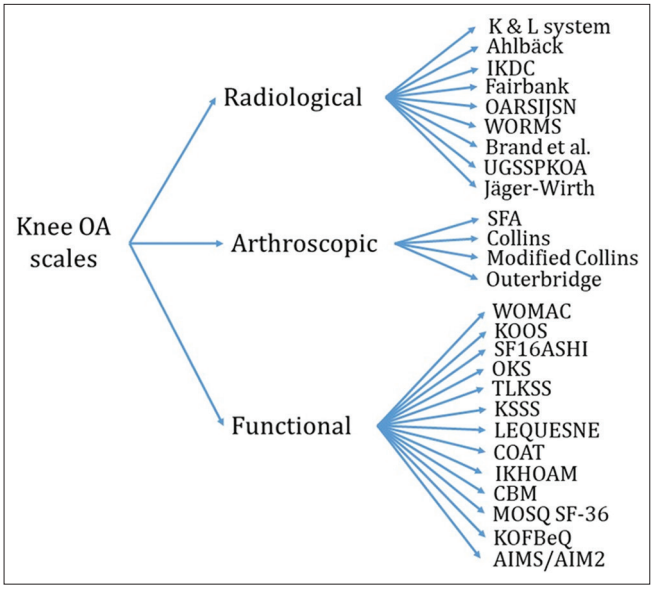

Figure 1: Classification of knee osteoarthritis scales
Abbreviations: K and L: Kellgren and Lawrence; IKDC: International knee documentation committee; OARSIJSN: Osteoarthritis Research Society International Joint Space Narrowing; WORMS: Whole-Organ Magnetic Resonance Imaging Score; UGSSPKOA: Ultrasonographic Grading Scale for Severity of Primary Knee Osteoarthritis; SFA: French Society of Arthroscopy; WOMAC: Western Ontario and McMaster University; KOOS: Knee Osteoarthritis Outcome Score; SF 36 ASHI: Short Form 36 Arthritis Specific; FSI: Functional Status Index; KSSS: Knee Society Scoring System; LEQUESNE: Osteoarthritis Severity Indices of Lequesne; COAT: Comprehensive osteoarthritis test; IKHOAM: Ibadan Knee Osteoarthritis Outcome Measure; CBM: Community Balance and Mobility Scale; AIMS: Arthritis Impact Measurement Scales; KOFBeQ: Knee Osteoarthritis Fears and Beliefs Questionnaire; and MOS SF-36: Medical Outcomes Study Questionnaire Short Form 36 Health Survey

the electronic search using the keywords encompassed within five primary key terms: "knee," "OA," "outcome," "physiotherapy," "exercise," and "India." These keywords were combined using the Boolean operators "AND," "OR," and "NOT."

Radiological Classification

Radiological classification OA scales being the pioneer of all OA scales, which are used in diagnosis.

Kellgren and Lawrence classification system

Kellgren and Lawrence system proposed in 1957 and accepted by the WHO in 1961, grades the severity of knee OA.[7] They classified the radiographic grading of OA under five-point ordinal scale. They are, Grade 0 - no radiographic findings of OA knee joint; Grade I - minute osteophytes of doubtful clinical significance and possible osteophytic lipping; Grade II - definite osteophytes with unimpaired joint space; Grade III - definite osteophytes with moderate joint space narrowing (JSN) and possible bony deformity; and Grade IV - definite large osteophytes with severe JSN, subchondral sclerosis, and definite bony deformity. They demonstrate a wide range of interobserver reliability (0.51–0.89).[8]

Ahlbäck classification of OA of the knee joint

In 1968, Ahlbäck *et al.* proposed the classification system for radiological grading of OA of the knee joint. According to them, there were six grades, Grade 0 - no radiographic findings of OA; Grade I - JSN <3 mm; Grade II - joint space obliteration; Grade III - minor bone attrition <5 mm; Grade IV - moderate bone attrition (5–15 mm); and Grade V - severe bone attrition (>15 mm). Ahlback system has poor interobserver reliability (0.11–0.23)[9] because it gives more importance to the bone loss and it becomes difficult to extrapolate among the individual in their early stages of OA.

International knee documentation committee IKDC

IKDC was formed in 1987, to identify and document the prognosis or deterioration in symptoms, function, and sports activities due to knee impairment. Originally, it was designed for the individual with an injury to the knee ligament. Later other knee impairments such as articular cartilage lesions, patellofemoral pain, ligament injuries, and meniscal injuries were described by them. They classified OA into four ordinal scale grading being, Grade A - No JSN; Grade B - joint space >4 mm with the presence of small osteophytes, slight sclerosis, or femoral condyle flattening; Grade C - joint space between 2 and 4 mm; and Grade D - joint space <2 mm. The IKDC system, which incorporates JSN is more informative had good reliability (0.6–0.8) and superior to all other classification system.[10]

OA research society international (OARSI) JSN grading system

OARSI JSN[11] grading system describes the severity of OA knee joint on four-point ordinal scale based on the percentage of JSN. They are, Grade I - normal (0% JSN); Grade II - mild (1–33% JSN); Grade III - moderate (34–66% JSN) and the last being, and Grade IV - severe (67–100% JSN).

Whole-organ magnetic resonance imaging

Whole-organ magnetic resonance imaging score (WORMS), semi-quantitative scoring system published by Peterfy *et al.*, in 2004. It examines the five features related to the articular surfaces. They are marginal osteophytes (eight-point scale, based on size and the extent of bone spur margin involvement), subarticular bone attrition (four-point scale, based degree of flattening or depression), cartilage signal and morphology (eight-point scale), subarticular bone marrow abnormality (three-point scale, based on the extent of regional marrow involvement), and subarticular cysts (three-point scale, based on focal bone loss).[12] The final WORMS scores are calculated as cumulative surface feature (osteophytes, bone

attrition, cartilage, marrow abnormality, and subarticular cysts) scores in each compartments, patellofemoral joint (PFJ), the medial femorotibial joint, and the lateral femorotibial joint of knee joint. It has excellent interrater reliability (Intraclass Correlation Coefficient (ICC) >0.9, $P < 0.01$) in all the five features except bone attrition feature (ICC = 0.61, $P < 0.01$ [MTFJ], ICC = 0.78, $P < 0.01$ (PFJ)].[12]

Ultrasonographic grading scale for severity of primary knee OA

Ultrasonographic grading scale for severity of primary knee OA was proposed by Mortada *et al.*, in 2016.[13] They graded the knee of PKOA into five grades (0–4) depended on the shape of distal femoral osteophytes. In which, Grade 0 being no osteophytes and Grade 4 has osteophytes which are superior and parallel to femoral bone with or without an inferior part in the joint space. Grade 4 is the advanced grade of KOA while Grade 0 means no OA. The interreader and intrareader reliability is good with kappa > 0.81, $P \leq 0.001$.

Brandt radiographic grading scale

Brandt radiographic grading scale of OA of the knee joint classifies the severity based on five-point ordinal scale. According to them, Grade 0 - no radiographic findings of OA; Grade I - < 25% JSN with secondary features; Grade II - 50–75% JSN without secondary features; Grade III - 50–75% JSN with secondary features, and Grade IV - > 75% JSN with secondary features. The secondary features are subchondral sclerosis, osteophyte formation, and subchondral cysts. This system is also based on JSN and demonstrated moderate interobserver reliability.

Fairbank classification of OA

Fairbank classified OA into five grades. They are, Grade 0 - normal; Grade I - squaring of tibial margin; Grade II - flattening of femoral condyle, squaring and sclerosis of tibial margin; Grade III - JSN, hypertrophic changes, or both, and Grade IV - 75% JSN with the secondary feature.

Jager-Wirth classification system

Similarly, Jager-Wirth used five-point ordinal scale to classify the severity of knee OA. According to them, Grade 0 - no arthrosis; Grade I - initial arthrosis, small osteophytes, and minimal JSN; Grade II - moderate arthrosis, approximately 50% JSN; Grade III - medium-grade arthrosis and the last is, and Grade IV - heavy arthrosis. To the best of author knowledge, no reliability studies are available for Fairbank and Jager-Wirth classification system.

Arthroscopy Classification

Arthroscopic classification provides detailed chondropathy such as depth consistency, size, and location of lesion of the knee joint. Arthroscopy classification includes three scales, Outerbridge,[14,15] Modified Outerbridge,[16] and French society of arthroscopy (FSA)[17] and a modified Collins classification.[18] These scales grade OA knee based on cartilage lesions.

Outerbridge arthroscopy classification

Based on patellar chondral lesions, in 1961 Outerbridge classified into four grades, Grade I - softening; Grade II - fragmentation/fissure of 1.25 cm or less; Grade III - fragmentation/fissure >1.25 cm; and Grade IV - bone erosion.

Modified Outerbridge arthroscopy classification

Modified Outerbridge classification grade the knee OA into five grades based on cartilage lesion, namely Grade 0 - normal articular cartilage, Grade I - articular cartilage softens, Grade II - superficial fissures and fibrillation appears over the cartilage, Grade III - deep fissures appears over the cartilage without exposing bone, and Grade IV - bone gets exposed.

FSA classification

In 1994 another grading system of classification was proposed by the FSA for grading chondropathy. They are Grade I - softening; Grade II - superficial fissure; Grade III - deep fissure; and Grade IV - bone exposure.

Collins classification

Based on cartilage destruction, Collins classified into four grades, Grade I - destruction of superficial cartilage; Grade II - more extensive cartilage destruction; Grade III - loss of cartilage in one or more pressure areas; and Grade IV - complete cartilage loss.

The intraobserver kappa (k) index of Outerbridge, FSA, and Collins were 0.29, 0.61, and 0.42, respectively, while interobserver kappa (k) index was 0.47, 0.49, and 0.45.[19,20] FSA classification system was moderately accurate in grading arthroscopic lesion when compared to other system.[20]

Functional Classification

The scales under functional classification are used to document the functional benefit among PKOA is tabulated in Table 1.

Western Ontario and Mcmaster university (WOMAC) OA index

WOMAC OA index was developed by Bellamy *et al.*[21] in 1982 for assessing their activities of daily living (ADL), functional mobility, gait, general health and quality of life (QoL) in PKOA and validated in 1988. It has total 24 items and three subscales, namely pain (5 items), stiffness (2 items), and function (17 items), scored on five-point ordinal scale, 0 - none, 1 - mild, 2 - moderate, 3 - severe, and 4 - extremely severe. Higher WOMAC scores indicate worse pain, stiffness, and functional

Table 1: Functional classification of outcome measures used in the rehabilitation of PKOA

Outcome measures	Authors	Administered by	Subscales/sections	Total number of item	Scoring with reliability	Validity
WOMAC osteoarthritis index	Bellamy *et al*. (1982)	Patient (self) -administered	Three subscales (pain, stiffness, and function)	24 item; pain (5 items) Stiffness (2 items) Function (17 items)	Pain (0–20) - ICC=0.90; Stiffness (0–8) - ICC=0.72; Function (0–68) - ICC=0.71. Total score=96 (Range, 0–96) Global ICC=0.83	High concurrent validity with Lequesne OA algofunctional index, SF-36, NHP
KOOS	Roos *et al*. (1990s)	Patient (self) -administered	Five subscales (Pain, symptoms, ADL, Sport/Rec, QoL)	42 items; pain (9 items) Symptoms (7 items) ADL function (17 items) Sport/Rec function (5 items) QoL (4 items)	Total score=100 (Range, 0–100) Pain, ICC=0.93; Symptoms, ICC=0.85; ADL function, ICC=0.91; Sport/Rec function, ICC=0.75; QoL, ICC=0.89	Concurrent validity with SF-36 is, $\rho = 0.40$ to 0.79
KOFBeQ	Benhamou *et al*. (2013)	Patient (self) -administered	Four subscales (daily living activities, physicians, disease, sports)	11-item questionnaire	Total score=99 (Range, 0–99). Good test-retest reliability, with an ICC of 0.81	NA
Osteoarthritis Severity Indices of Lequesne	Lequesne (1980)	patient-administered (but sometimes require an interviewer)	Three sub-scales (pain, maximum distance walked, and ADL)	11-item questionnaire	Total score=24 (Range, 0–24). Internal reliability (Cronbach's alpha) is, 0.84 (95% CI: 0.81–0.86)	Concurrent validity with SF-36 is, $\rho = -0.28–0.78$. Strongest correlation with physical function, $\rho = -0.78$
Tegner Lysholm Knee Scoring Scale	Lysholm *et al*. (1982) and Tegner *et al*. (1985)	Patient (self) -administered	Eight sections (categories of limping, support, locking, instability, pain, swelling, stair climbing, and squatting)	pain (25 points) Instability (25 points) Locking (15 points) Swelling (10 points) Limp (5 points) Stair climbing (10 points) Squatting (5 points) Need for support (5 points)	Total score=100 (Range, 0-100) Higher the scores, lesser the disability. It has acceptable test-retest reliability of, ICC=0.88-0.97	Acceptable criterion validity and construct validity.
COAT	Brooks *et al*. (2004)	Physician/physical therapist administered	Four subscales (pain, stiffness, difficulty with physical activity, and overall symptom)	Not available*	Not available*	
IKHOAM	Akinpelu *et al*. (2007)	Both patient and physician/ physical therapist administered	3-domain/part (activity limitations, participation restrictions, physical performance tests)	33- items	Total score=232 (Range, 0-232) Activity limitations-200 Participation restrictions-9 Physical performance tests-23. The test–retest, intrarater and interrater reliability for PKOA measured ranged from 0.94–0.99 ($P<0.01$), 0.96 ($P<0.05$) and 0.60 ($P<0.05$) respectively	Fair level of concurrent validity with visual analog scale (VAS), $r = -0.32$ to $r = -0.46$
CB&M	Howe *et al*. (2006)	Physician/physical therapist administered	13 tasks, including bending, turning, or looking while walking, single-leg standing and stair descent	13-items	Total score=96 (Range, 0–96). High test-retest reliability of ICC=0.95	r=0.52–0.74, with Berg Balance Scale, Timed "Up and Go" Test, single-leg stance time, and the 10-mr Walk Test.

(Contd...)

Table 1: *Continued*

Outcome measures	Authors	Administered by	Subscales/sections	Total number of item	Scoring with reliability	Validity
SF-36	Ware *et al*. (1999)	Both patient and clinician/ surgeon administered	Eight subscales (vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning, and mental health status)	11 main questions subdivided into 36 items	Total score=100 (Range, 0–100) and has excellent reliability (ICC>0.90) in physical and mental sections	Good validity ($r \geq 0.89$)
OKS	Dawson *et al*. (1998)	Patient (self) -administered	Pain and function	12-item	Total score=48 (Range, 0–48). Excellent test-retest reliability of OKS summary scale, its pain and functional component with ICC=0.93, 0.91 and 0.92 respectively.	Good concurrent validity with ICOAP (Intermittent and Constant Osteoarthritis Pain) of $\rho = -0.88$ and with KOOS-PS (Knee Injury and OA Score-Physical Function Short Form) of $\rho = -0.85$
KSSS	Insall *et al*. for knee society (1989)	Both patient and clinician/ surgeon administered	Two portions (knee score and function score)	Knee score: Pain, range of movement, flexion deformities, contractures, alignment, and stability in the anteroposterior and mediolateral planes Function score: Patient's mobility (walking distance and stairs) and potential walking aids	Total score=100 (Range, 0-100) for each portion with inter-rater reliability of ICC=0.80. (Pain, ICC=0.84; ROM, ICC=0.88; flexion contracture=0.70; Mediolateral Stability, ICC=0.51; Extension deficit, ICC=0.53; Anteroposterior stability, 0.25 and Alignment, ICC=0.21).	Moderate cross-sectional and longitudinal validity with, r=0.60–0.73
ASHI	Ware *et al*. (1999)	Both patient and clinician/ surgeon administered	Eight subscale (five arthritis-specific measures of disease severity [knee pain on weight bearing, time to walk 50 feet, physician global evaluation of symptom severity and impact, patient global evaluation of symptom severity and impact, and pain intensity visual analog scale])	11 main questions subdivided into 36 items	Total score=100 (Range, 0–100)	Strong correlations with SF-36 scales (r=0.92)
AIMS/AIMS2	Meenan *et al*. (1980, AIMS) and (1992, AIMS2)	Patient (self) -administered	AIMS: 9-subscales AIMS2: 12-subscales	AIMS: 45-items; Shortened AIMS: 18-items; AIMS2: 101-items; Shortened AIMS2: 26-items	Total score=60 (range, 0–60) 0–10 for each section. The 95% confidence test-retest reliability range from, ICC=0.78–0.94	Strong concurrent correlations, (r>0.75) with HAQ and moderate correlations, (r=0.5–0.74) with VAS and SF-36

WOMAC: Western Ontario and McMaster University, KOOS: Knee osteoarthritis outcome score, SF 36 ASHI: Short Form 36 arthritis-specific, FSI: Functional status index, KSSS: Knee society scoring system, COAT: Comprehensive osteoarthritis test, IKHOAM: Ibadan knee osteoarthritis outcome measure, AIMS: Arthritis impact measurement scales, KOFBeQ: Knee osteoarthritis fears and beliefs questionnaire, HAQ: Health assessment questionnaire, VAS: Visual analog scale, *The authors (Lyndon Brooks et al., (2004) actually never made the test instrument (COAT) beyond the one that the published as the experimental work for their paper (confirmed by e-mail (lyndon.brooks@scu.edu.au) communication with Prof. (Dr). Lyndon Brooks on 03 March, 2018)).

limitations. The test-retest reliability for pain, stiffness, and function is ICC = 0.74, 0.58, and 0.92, respectively.[22] It would take approximately 12 min to complete the whole WOMAC directly or indirectly over telephone or online.

Knee injury and OA outcome score (KOOS)

KOOS was developed by Roos *et al.*, in the 1990s, as a patient self-reported opinion regarding their knee and associated problems.[23] It is an extension of WOMAC OA index. It has 42 items and scored under five subscales, namely pain, other symptoms, ADL, function in sport and recreation (Sport/Rec), and knee-related QoL. It has the acceptable reliability of ICC >0.8 in all subscales, except ADL in sport and recreation having ICCs between 0.45 and 0.65. The main intention for the development of KOOS is to document the clinical changes following knee injuries such as knee ligament injury, meniscal tears, knee cartilage lesions, osteochondritis dissecans, and knee OA that can result in posttraumatic knee OA or secondary knee OA.

Knee OA fears and beliefs questionnaire

Knee OA fears and beliefs questionnaire (KOFBeQ) was developed by Benhamou *et al.*, in 2013, for assessing the unrealistic fears and beliefs of PKOA.[24] It has four subscales, namely daily living activities (3 items), physicians (4 items), disease 9 (2 items), and sports (2 items), totaling 11 items and scored in 10-point numeric scale (0–9). It helps in identifying the potential barriers to treatment adherence and planning better management. Test-retest reliability of KOFBeQ was good with an ICC of 0.81 (95% confidence interval [CI] 0.64–0.90).[24]

OA severity indices of lequesne

The OA severity indices of lequesne, algofunctional index for OA knee is devised by rheumatologists, Lequesne in late 1980 and validated in 1981 to assess the severity for OA of knee and hip in an elderly population.[25,26] It is an 11-item questionnaire of subjective nature used as a part of interview to obtain information from patients, about their diseased hip. Patients' responses with references to pain, maximum distance walked and ADL are recorded to generate a single composite scale.[25]

Tegner lysholm knee scoring scale (TLKSS)

TLKSS was initially published as a physician-administered score in 1982 to document the functional outcome of knee ligament surgery. But later TLKSS was extended to measure the patient with, meniscal tears, patellofemoral pain, traumatic knee dislocation, knee cartilage lesions, osteochondritis dissecans, patellar instability, and knee OA. 3 years later, the Tegner activity scale was published by the addition of work and sport activities. Now, TLKSS is validated as patient-administered scores for the responsiveness after the treatment of anterior cruciate ligament tears. The total score is 100 (range, 0–100) which is scored under eight sections; pain (25 points), instability (25 points), locking (15 points), swelling (10 points), limp (5 points), stair climbing (10 points), squatting (5 points), and need for support (5 points). It has the acceptable test-retest reliability of, ICC = 0.88–0.97.

Comprehensive OA test (COAT)

COAT is a simple index to measure the severity of symptom among the patients with hip and knee OA.[27] COAT was constructed to assess the three main components of OA, pain, stiffness, and physical dysfunction both WOMAC and COAT are highly reliable (WOMAC alpha = 0.98; COAT alpha = 0.97) when measured over weeks among the patient with hip and knee OA. However, this scale was developed beyond its infancy.

Ibadan knee OA outcome measure (IKHOAM)

IKHOAM, measures both self/patient- and clinician/observer-measured items among PKOA, was developed by Akinpelu *et al.*, in 2007.[28] It has three domain, activity limitations, participation restrictions, and physical performance test.[29] Activity limitations domain composed of 25 ADL items that are being performed by PKOA. The degree of difficulty and assistance required in carrying out the activities are rated on a 5 point (0–4) ordinal scale. Second, participation restriction domain has three restricted activities in societal participation due to knee/hip OA. The activities restrictions experienced in carrying out the activities are rated on a 4 point (0–3) ordinal scale. Third, physical performance tests domain which includes five tests that are rated by the clinician. These tests are; (1) 250m walk test rated on a 6 point (0–5) ordinal scale, (2) one leg stance test rated on a 6 point (0–5) ordinal scale, (3) stairs climbing test rated on a 5 point (0–4) ordinal scale, (4) squat test rated on a 5 point (0–4) ordinal scale, and (5) balance test rated on a 6 point (0–5) ordinal scale. The maximum obtainable score on IKHOAM is 232 (200+9+23).[29] The minimal clinically important difference for IKHOAM among PKOA (23 males and 101 females) aged 59.2 ± 11.5 years was 12.8. The score for PKOA was calculated in percentage as individual's score/total possible score × 100. The test-retest, intrarater, and interrater reliability for PKOA measured ranged from 0.94 to 0.99 ($P < 0.01$), 0.96 ($P < 0.05$), and 0.60 ($P < 0.05$), respectively.[29] It takes about 15 min to complete the test.

Community balance and mobility scale (CB and M)

The CB and M was developed by Howe *et al.*, in 2006, to assess functional deficits in both dynamic balance and mobility at their community level.[30] The scale was originally designed to assess advanced balance and mobility activities such as rapid direction changes and dual tasking in young patients after traumatic brain injury.[30] The CB and M comprises 13 tasks includes, unilateral stance (R and L), tandem walk, 180° tandem pivot, lateral foot scooting (R and L), hopping forward (R and L), crouch and walk, lateral dodging, walking and looking

(R and L; over an 8-m distance), running with controlled stop, forward to backward walking, walk (over an 8-m distance), look and carry (R and L), and descending stairs and step-ups (R and L; performance of 5 step-ups onto a stair).[31] The maximum score is 96, with a minimum score of 0. It has concurrent validity of 0.52, 0.74, 0.71, 0.61, and 0.69 with Berg Balance Scale, Timed up and go test, single-leg stance, self-selected gait speed, and fast gait speed, respectively. It has excellent test-retest reliability ICC = 0.95 (95% CI = 0.70–0.99), SEM = 3 (95% CI = 2.68–4.67) with 95% minimal detectable change value is 10.[31]

QoL in PKOA

QoL in PKOA (QoL-PKOA) can be assessed with medical outcomes study questionnaire short form 36 health survey (MOS SF-36) was developed by Ware *et al.*, in 1992.[32] It estimates overall health status under eight sections; vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning, and mental health status. The total score is 100 (range, 0–100) with higher scores lesser disability.[32,33]

Oxford knee score (OKS)

The OKS was developed by Dawson *et al.*, to document patients perceptions on replacement surgeries, in 1996 for hip and 1998 for knee.[34,35] It is a 12-item knee joint-specific patient-reported outcome measures for the assessment of function and pain in PKOA.[35] The OKS has proven to be valid, reliable, and responsive to document clinical changes following intervention to knee. Recommended revised scoring system scores each item in 5-point ordinal scale, 0 (worst) to 4 (best) and with summed up total score range from, 0 to 48.[36] Minimum detectable change and minimal clinical important change for OKS are 5 and 9 points, respectively.[37] The 12-item questionnaire has been used in several clinical studies and translated into various languages with cross-cultural adaptation.

Knee society scoring system (KSSS)

The KSSS is a simple, but objective scoring system developed by Insall *et al.*[38] for knee society to document the knee and patient's functional abilities such as walking and stair climbing before and after TKA due to OA knee. It has two portions, first being, clinician/surgeon-rated portion (Knee Score) of KSS, which covers pain, range of movement, flexion deformities, contractures, alignment, and stability in the anteroposterior, and mediolateral planes. Second, patient-reported portion (Function Score) of KSS which covers the patient's mobility (walking distance and stairs) and potential walking aids in PKOA before and after TKA.[39,40] The total score of each portion, knee score and function score range from 0 to 100 points with higher scores indicating a better outcome.

SF-36 arthritis-specific health index (ASHI)

The SF-36 ASHI, published in 1999 was developed by John E Ware for studying the changes in clinical severity of knee OA and rheumatoid arthritis.[41] It measures the impact of knee OA/rheumatoid arthritis on, bodily pain, physical role, physical functioning, social functioning, vitality, and clinical measures such as 50ft walk test.

Arthritis impact measure (AIM)

AIM was developed by Meenan *et al.*, in 1980, to measure 55 health status items under 9 scale groups. They are mobility (5 status items), physical Activity (5 status items), social Role (7 status items), social activity (9 health status items), pain (5 status items), dexterity (5 status items), activities of daily living (5 status items), anxiety (8 status items), and depression (6 status items).[42] AIM was revised in 1992 and renamed as AIM2 by the addition of three scale groups; arm function, social support, and work. Thus, the original AIM has 55-items while the revised version, AIM2 has 101-items with 95% confidence test-retest reliability range from, ICC = 0.78–0.94.[43]

Discussion

We have summarized the outcome measures used in PKOA and hope; this review would highlight the names of various scales used in PKOA. From Table 1, it was evident that Oxford knee score has excellent test-retest reliability (ICC >0.9) and good concurrent validity with Intermittent and constant OA pain of $\rho = -0.88$ and with KOOS-physical function short form of $\rho = -0.85$. WOMAC has excellent reliability with pain subscale (ICC = 0.90) and high concurrent validity with Lequesne OA algofunctional index, SF-36 and NHP. OA Severity Indices of Lequesne has good internal reliability but have fair to strong concurrent validity with SF-36. IKHOAM, KOOS (pain and ADL function) and CB and M have excellent test-retest reliability but non-acceptable level of concurrent validity with criterion measures. Available evidence on the scales used in the diagnosis, prognosis, and rehabilitation of PKOA, confirms that both Oxford knee score and WOMAC have excellent reliability and good validity. All the available scales are from the developed countries, except IKHOAM. We hope, this collection of outcome measure used in the diagnosis, prognosis, and rehabilitation of PKOA would encourage the development of new scales by combining the items of the above in a single scale, CKOI in PKOA to facilitate the patient-centered outcome research. In developing countries like India, still, we use the scales validated and available from the developed countries. This will not reflect the actual treatment effect among PKOA due to cross-cultural variation. None of the scale is available from India. There is real need to develop the outcome measures to be used in diagnosis, prognosis, and rehabilitation of PKOA.

Conclusion

The collection of outcome measure used in the diagnosis, prognosis, and rehabilitation of PKOA is summarized. We hope this review will assist in educating orthopedician,

physiotherapist, and academician and researchers on the available in the diagnosis, prognosis, and rehabilitation of PKOA. This review highlights the need for patient-reported outcome measures from the developing countries to document actual treatment effect.

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