Reliability of the Jones Patellofemoral Osteoarthritis Score for Radiological Assessment of Patellofemoral Degenerative Changes: Comparing a Physiotherapist to Doctors

T.O. Smith, MSc, MCSP;* S.-N. Kang, FRCS (Tr & Orth);† W.B. De Sprenger Rover, MRCS;‡ N.P. Walton, FRCS (Tr & Orth)‡

ABSTRACT

Purpose: Radiological measurement scores are used by orthopaedic physiotherapists in triage and surveillance of patients with degenerative changes of the tibiofemoral and patellofemoral joints. The purpose of this study was to estimate the intra- and inter-observer reliability of a radiological measurement score to assess patellofemoral joint osteoarthritis, the Jones Patellofemoral Osteoarthritis Score (JPOS), with an orthopaedic physiotherapist and three grades of junior surgeons/doctors. **Methods:** A total of 390 skyline X-rays of the patellofemoral joint were reviewed on 2 occasions, 4 weeks apart, by an orthopaedic physiotherapist, 2 orthopaedic surgeons, and an orthopaedic doctor. Intra- and inter-observer reliability of the JPOS was calculated using a weighted kappa analysis. **Results:** The results indicated that while there was good overall intra-observer agreement for this measurement score for all assessors, inter-observer reliability was generally poor between the orthopaedic physiotherapist and the orthopaedic surgeons/doctor. **Conclusion:** Our findings call into question the use of the JPOS by orthopaedic physiotherapists working in triage or orthopaedic surveillance programmes with other orthopaedic clinicians.

Key Words: patella; radiography; physical therapy; reliability of results.

RÉSUMÉ

Objectif : Les mesures radiologiques sont utilisées par les physiothérapeutes orthopédiques pour le triage et la surveillance des patients qui vivent des changements dégénératifs à l'articulation fémorotibiale et à l'articulation patellofémorale. L'objectif de cette étude était d'estimer, avec un physiothérapeute orthopédique et trois catégories de chirurgiens et médecins novices, la fiabilité intra et interobservateur d'une mesure radiologique pour l'évaluation de l'arthrose patellofémorale à l'aide de l'échelle d'arthrose patellofémorale de Jones (JPOS). **Méthode :** Au total, 390 incidences fémoropatellaires ont été examinées en deux occasions, à quatre semaines d'intervalle, par un physiothérapeute orthopédique, par deux chirurgiens orthopédiques et par un orthopédiste. La fiabilité intra et interobservateur de la JPOS a été calculée à l'aide du coefficient Kappa pondéré. **Résultats :** Les résultats ont indiqué que bien que tous les évaluateurs étaient plutôt d'accord avec cette échelle de mesure, la fiabilité interobservateur était généralement faible entre les physiothérapeutes orthopédiques et les chirurgiens orthopédiques et orthopédistes. **Conclusion :** Nos conclusions remettent en questions l'utilisation due la JPOS par les physiothérapeutes orthopédiques qui travaillent au triage ou dans des programmes de surveillance orthopédique avec d'autres cliniciens en orthopédie.

Osteoarthritis (OA) of the knee joint is a common disorder that is functionally disabling.^{1,2} Although OA of the tibiofemoral joint is more common, patellofemoral OA is an important cause of disability for a large number of patients.^{3,4}

With the evolution of health care and growing demands on hospital orthopaedic services, physiotherapists as well as junior doctors have become established as part of the multidisciplinary team assessing and treating patients in extended-scope orthopaedic roles.^{5,6} Physiotherapists'

practice has required them to develop the skills to perform radiological assessment tasks previously undertaken by orthopaedic junior doctors and more experienced orthopaedic consultants in both community and hospital settings.^{7,8}

Patellofemoral joint OA has traditionally been assessed using the Kellgren and Lawrence⁹ scoring system, a general radiological OA scoring system.¹⁰ More recently, Jones and colleagues¹¹ devised the Jones Patellofemoral Osteoarthritis Score (JPOS) to evaluate the presence and

From the *University of East Anglia; ‡Norfolk and Norwich University Hospital, Norwich; †Royal Orthopaedic Hospital, Stanmore, London, UK.

Correspondence to: Mr. Toby O. Smith, Faculty of Medicine and Health Sciences, Queen's Building, University of East Anglia, Norwich NR4 7TJ UK; toby.smith@uea.ac.uk.

Contributors: All authors designed the study, collected the data, and analyzed and interpreted the data; drafted or critically revised the article; and approved the final draft.

Competing interests: None declared.

Physiotherapy Canada 2012; 64(3);257–261; doi:10.3138/ptc.2011-16

extent of patellofemoral degenerative changes. Understanding the intra- and inter-observer reliability of any measurement scoring system used in clinical practice is essential to ascertaining its appropriateness.¹² In light of the development of extended-scope physiotherapy roles in the orthopaedic setting, we set out to assess the reliability of the JPOS when used by different clinicians, including physiotherapists, working in orthopaedic practice. The purpose of the present study, therefore, was to evaluate the intra- and inter-observer reliability of the JPOS for the assessment of patellofemoral joint degenerative changes with an orthopaedic physiotherapist and three different grades of orthopaedic surgeons/doctors.

METHODS

A retrospective observational study design was undertaken to assess the reliability of the JPOS with various health care professionals.

Participants

As part of a convenience sampling strategy, we retrospectively reviewed the Norfolk and Norwich University Hospital's prospective database of all Oxford Phase III Unicompartmental Knee Replacements (Biomet, UK) performed from January 2004 through July 2007. Cases were included when both preoperative and postoperative skyline radiographs were available for review, for a total of 195 knees (162 patients). Pre- and postoperative digital radiographs were retrieved for each patient from the institution's Patient Archiving and Communication System (PACS) computer database. Demographic data (patient age, gender, and side of knee assessed) were collected retrospectively from the institution's database.

As this study was a retrospective review of X-rays, no patients were approached or involved in this retrospective review, and ethics approval was therefore not required.

Measurement

Examination of preoperative and postoperative skyline radiographs permitted the assessment of 390 images. Radiographs were assessed using the JPOS,¹¹ which assesses five domains: the presence of joint-space narrowing, osteophytes, cyst formation, sclerosis, and joint attrition. Each of these five domains is assessed on a 4-point numeric scale (0 = no signs of degenerative change; 1 = possible or minimal features; 2 = moderate or definable features; 3 = total loss of joint space and large or widespread signs of degenerative changes).¹¹ The sum of the domains is calculated, for a maximum score out of 15; a higher score indicates greater radiological changes. The JPOS has been shown to be valid for the assessment of patellofemoral osteoarthritic changes by rheumatologists and radiologists.¹¹

X-ray assessors and procedure

The assessors in this study were two orthopaedic surgeons with different levels of experience (9 and 5 years post-graduation), an orthopaedic doctor (2 years post-

graduation), and an orthopaedic physiotherapist (8 years post-graduation). Each surgeon was randomly allocated a block of 124 to 140 consecutive X-rays (62–70 preoperative and 62–70 postoperative images). The orthopaedic physiotherapist assessed all 390 X-rays (195 pre- and 195 postoperative). Before the study began, each assessor was given a copy of the original paper on the JPOS,¹¹ which outlines the method of performing this assessment and the associated scoring system. This paper was discussed and reviewed by all assessors, and X-ray reviews began only once each assessor was satisfied with the assessment method and the overall scoring system.

Four weeks after the initial X-ray assessment, each assessor re-evaluated the first 50 X-rays (25 pre- and 25 postoperative) from his or her initially allocated sample. This enabled us to assess intra-observer reliability.

To minimize bias, we instructed each assessor to review each X-ray independently from the other assessors and not to discuss or seek external help on scoring; assessors remained blinded to their original X-ray scores during the intra-observer reliability assessment.

Data analysis

Descriptive statistics were calculated for patient demographics, including frequency, median, and inter-quartile range values. To assess intra-observer reliability, a weighted kappa analysis (quadratic weights) with 95% confidence interval (CI) was performed for each assessor, comparing the first to the second assessments for each of the 50 X-rays reviewed twice.¹³ To assess inter-observer reliability, weighted kappa analysis with 95% CI was performed to evaluate the chance-corrected agreement between the results of the orthopaedic physiotherapist and those of the orthopaedic surgeons and the orthopaedic doctor.¹³

Each weighted kappa analysis was interpreted using Landis and Koch's¹⁴ suggested interpretation: <0.0 = no agreement, 0–0.20 = slight agreement, 0.21–0.40 = fair agreement, 0.41–0.60 = moderate agreement, 0.61–0.80 = substantial agreement, and 0.81–1.00 = very good agreement. We considered a result of "very good agreement" to be acceptable for clinical practice.

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 16.0 for Windows (SPSS Inc., Chicago, IL).

RESULTS

Patient demographics are presented in Table 1. The frequency of results for each of the five domains for each assessor is presented in Table 2, indicating a general trend whereby the orthopaedic doctor reported more severe degenerative changes than either the orthopaedic surgeons or the orthopaedic physiotherapist. This trend was most notable for the joint sclerosis criterion (see Table 2).

Inter-observer reliability

As Table 3 shows, there was considerable variation in agreement between the surgeons and the physiotherapist

Table 1 Study Characteristics

Study characteristics	No.*
Patients	163
Sex	
Male	93
Female	70
Median age and (IQR), y	65.0 (59–72)
Knees	195
Side	
Left	94
Right	101

* Unless otherwise indicated.

IQR = Inter-quartile range.

Table 2 Frequency of Results for Each of the Five Domains for Each Assessor

JPOS criteria	Clinician	Grade			
		0	1	2	3
Joint-space narrowing	OP	286	81	22	1
	OD	34	35	44	27
	OS1	5	13	56	50
	OS2	50	48	25	3
Osteophyte	OP	236	129	25	0
	OD	32	79	22	7
	OS1	5	24	45	50
	OS2	7	86	32	1
Cyst	OP	372	115	2	0
	OD	102	36	2	0
	OS1	8	60	45	11
	OS2	124	2	0	0
Sclerosis	OP	203	176	11	0
	OD	71	58	11	0
	OS1	1	11	37	75
	OS2	119	7	0	0
Attrition	OP	365	25	0	0
	OD	113	27	0	0
	OS1	81	42	1	0
	OS2	126	0	0	0

JPOS = Jones Patellofemoral Osteoarthritis Score; OP = orthopaedic physiotherapist, 8 y post-graduation; OD = orthopaedic doctor, 3 y post-graduation; OS1 = orthopaedic surgeon 1st, 5 y post-graduation; OS2 = orthopaedic surgeon 2nd, 9 y post-graduation.

on the individual domains of the JPOS. The results indicated fair to moderate agreement for three of the five domains; the exceptions were joint attrition and cyst formation, which showed poor to no agreement between the orthopaedic physiotherapist and each of the other assessors (see Table 3). For the total JPOS, however, there was moderate to substantial agreement between the orthopaedic physiotherapist and each of the other assessors: weighted kappa values ranged from 0.56 (95% CI, 0.39–0.69) to 0.66 (95% CI, 0.52–0.76).

Intra-observer reliability

There was greater intra-observer compared to inter-observer agreement (Table 3; Table 4) When results

Table 3 Inter-observer Reliability Results for the JPOS Rated by the Physiotherapist Compared to Each of the Orthopaedic Doctors

JPOS criteria	Clinician	κ -value	95% CI
Joint-space narrowing	OD	0.27	−0.04–0.49
	OS1	0.32	0.06–0.52
	OS2	0.56	0.37–0.69
Osteophyte	OD	0.50	0.29–0.65
	OS1	0.43	0.20–0.59
	OS2	0.39	0.13–0.57
Cyst	OD	0.54	0.34–0.68
	OS1	0.34	0.08–0.53
	OS2	−0.08	−0.54–0.24
Sclerosis	OD	0.28	−0.02–0.05
	OS1	0.33	0.07–0.52
	OS2	0.25	−0.06–0.48
Attrition	OD	0.07	−0.33–0.35
	OS1	−0.10	−0.54–0.21
	OS2	0.00	0.42–0.30
Total score	OD	0.57	0.39–0.70
	OS1	0.56	0.39–0.69
	OS2	0.66	0.52–0.76

JPOS = Jones Patellofemoral Osteoarthritis Score; OD = orthopaedic doctor; OS1 = orthopaedic surgeon 1st; OS2 = orthopaedic surgeon 2nd.

Table 4 Intra-observer Reliability Results of the Jones Patellofemoral Score

JPOS criteria	Clinician	κ -value	95% CI
Joint-space narrowing	OP	0.87	0.78–0.92
	OD	0.76	0.57–0.86
	OS1	0.54	0.19–0.73
	OS2	0.74	0.52–0.87
Osteophyte	OP	0.68	0.46–0.81
	OD	0.72	0.51–0.84
	OS1	−0.22	−1.12–0.30
	OS2	0.60	0.26–0.78
Cyst	OP	0.71	0.52–0.83
	OD	0.53	0.18–0.73
	OS1	0.55	0.21–0.74
	OS2	0.00	−0.83–0.45
Sclerosis	OP	0.70	0.49–0.82
	OD	0.06	−0.66–0.47
	OS1	0.15	−0.48–0.51
	OS2	0.00	−0.83–0.45
Attrition	OP	1.00	1.00–1.00
	OD	0.60	0.29–0.77
	OS1	0.38	−0.08–0.64
	OS2	1.00	1.00–1.00
Total Score	OP	0.81	0.68–0.89
	OD	0.73	0.52–0.85
	OS1	0.62	0.34–0.78
	OS2	0.72	0.49–0.85

JPOS = Jones Patellofemoral Osteoarthritis Score; OD = orthopaedic doctor; OS1 = orthopaedic surgeon 1st; OS2 = orthopaedic surgeon 2nd.

were analyzed by individual domain, there appeared to be good agreement for each of the domains when assessed by the orthopaedic physiotherapist. High intra-observer reliability was also demonstrated by the second

orthopaedic surgeon for all domains except cyst formation and sclerosis (Table 4). The first orthopaedic surgeon demonstrated good intra-observer reliability only for joint-space narrowing and cyst formation (Table 4). Finally, the orthopaedic doctor demonstrated good agreement between first and second assessments for all domains except sclerosis. The combined JPOS showed substantial agreement for the surgeons/doctors and very good agreement for the orthopaedic physiotherapist ($\kappa = 0.81$; 95% CI, 0.68–0.89; see Table 4).

DISCUSSION

While we found substantial intra-observer agreement on the JPOS for both the orthopaedic physiotherapist and the orthopaedic surgeons/doctor in our study, inter-observer agreement was limited, with generally poor agreement between the orthopaedic physiotherapist and each of the orthopaedic surgeons/doctor.

Our findings indicate that the reliability of the JPOS is variable. The previous study that assessed the JPOS reported higher inter- and intra-observer reliability values for this measure.¹¹ This difference may be attributed to two factors. First, although discussion was permitted among assessors before the X-rays were reviewed, to ensure that each assessor had a basic level of knowledge of the JPOS, no formal, standardized training or quality evaluation was provided in our study. Although we considered this an appropriate approach to assess the accuracy of the JPOS based on the original source material and informal teaching, it did permit variation among assessors in terms of their experience with other OA grading methods, and this may have biased the results. To address this bias stemming from participants' different level of experience, previous researchers have sought to standardize assessment methods. For instance, in the study by Jones and colleagues,¹¹ each assessor evaluated 20 X-rays, which were then discussed with a consultant radiologist as part of a training programme. This approach may have increased the likelihood of agreement among assessors. Second, the assessors in Jones and colleagues'¹¹ study, unlike those in our research, were radiologists and rheumatologists. It therefore remains unclear whether previous experience is an important factor or whether a certain amount of training is required to use the JPOS. Further study may be warranted to determine the importance of a training effect and whether previous experience in radiological assessment on the part of the assessor can improve the reliability of the JPOS.

The JPOS may be used by physiotherapists in two ways. First, physiotherapists, like other orthopaedic clinicians, are involved in surveillance and monitoring of patients following joint arthroplasty.^{15,16} As well as assessing clinical outcomes, this can involve assessment of radiological measurement scores, including the progression of osteoarthritic changes and osteolysis or joint loosening;

the JPOS can be used to assess the former. Second, physiotherapists are now involved in triaging patients for surgical management.^{5,6} The results of scores such as the JPOS can inform physiotherapists as to the degree of degeneration within the patellofemoral joint. Given the acceptable intra-observer agreement of the JPOS, its use in monitoring such patients in triage or arthroplasty surveillance by a single clinician may be indicated. Because inter-observer reliability is poor, however, the JPOS may not be an appropriate measurement when surveillance and triaging are undertaken collectively by multidisciplinary orthopaedic teams, as is frequently the case.

The agreement between patellofemoral degenerative scores and patient-reported outcomes has been questioned in the literature.⁴ Some authors have suggested that the symptoms of knee and, specifically, patellofemoral OA are poorly correlated with radiographic findings.^{17–19} As a result, clinicians have been advised to interpret the findings of radiological investigations as a part of a clinical assessment or evaluation rather than in isolation. Our findings, which show limitations in the reliability of the JPOS, lend further support to this view.

Our findings should be interpreted in light of several potential limitations of the present study. First, while our study investigated the reliability of the JPOS for physiotherapists versus other members of the orthopaedic team, it remains unclear how the findings of an orthopaedic physiotherapist relate to those of a consultant orthopaedic surgeon. This question cannot be answered by the available data. Second, we did not formally standardize the skyline view taken for the patients whose radiographs were reviewed; although the institution's radiological protocol was to perform all skyline views at 30° of knee flexion, it became clear during the X-ray review phase of our study that this protocol was not always followed: variability was estimated at between 30° and 45° of flexion. Although previous studies have not determined whether the specific angle of knee flexion is an important determinant of accuracy for the JPOS, this may be the case, since the position of patellar engagement could affect the view of the articular surfaces and thus create a confounding variable.²⁰

Our analysis included patients' preoperative and postoperative radiographs, since the purpose of this study was to assess the reliability of the JPOS, irrespective of when the X-ray was taken. Furthermore, we did not undertake a formal power calculation, because no study had previously been undertaken on which such a calculation could be based. Accordingly, a convenience sampling strategy was used. Including all potential X-ray findings (both pre- and postoperative) reduced our chances of committing a type II statistical error.¹³

Finally, no formal adjustment was made during the analysis for the effects of assessing multiple radiographs (pre- and postoperative) for each patient. However, assessors were advised to interpret each X-ray separately

and not to be influenced by the findings of the previous X-ray. This was emphasized by the fact that the mean period between preoperative and postoperative X-rays was 3.4 years (range, 2–7 y), allowing the potential for natural patellofemoral joint degenerative changes to have occurred over time.

CONCLUSIONS

Our study demonstrates substantial intra-observer reliability for the Jones Patellofemoral Osteoarthritis Score (JPOS) as assessed by an orthopaedic physiotherapist and by orthopaedic surgeons/doctors, but low inter-observer reliability between these members of the multi-disciplinary orthopaedic team. This finding calls into question the appropriateness of the JPOS for use in triage or surveillance of patellofemoral joint OA by orthopaedic physiotherapists.

KEY MESSAGES

What is already known on this topic

Physiotherapists' practice has required the development of skills to perform radiological assessment, tasks previously undertaken by orthopaedic doctors and surgeons. Previous literature has reported that the Jones Patellofemoral Osteoarthritis Score is a reliable radiological tool to assess patellofemoral osteoarthritis on X-ray when used by radiologists. No studies have assessed the intra- or inter-observer reliability of this score with physiotherapists relative to orthopaedic doctors.

What this study adds

This is the first study to assess the intra- or inter-observer reliability of the Jones Patellofemoral Osteoarthritis Score with physiotherapists relative to orthopaedic doctors. The findings indicate that this score demonstrated substantial intra-observer agreement for both the orthopaedic physiotherapist and the orthopaedic doctors in this study; inter-observer agreement was limited, however, with generally poor agreement between the orthopaedic physiotherapist and each of the orthopaedic surgeons/doctors.

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