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CONTEMPORARY METHODS IN PATELLOFEMORAL JOINT RADIOGRAPHY AND GRADING OF PATELLOFEMORAL OSTEOARTHRITIS: A SYSTEMATIC REVIEW

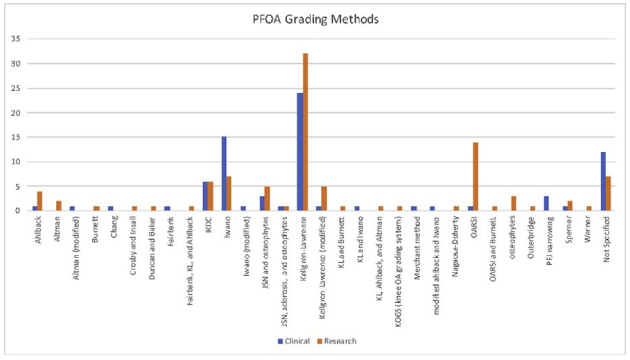
J.R. Hill [1,2], E.H. Oei [3], K.M. Crossley [4], H.B. Menz [4], E.M. Macri [3], M.D. Smith [1], N. Wyndow [4], L. Maclachlan [1], N.J. Collins [1]. [1] *The Univ. of Queensland, Brisbane, Australia;* [2] *Ochsner Clinical Sch., New Orleans, LA, USA;* [3] *Erasmus MC Univ. Med. Ctr., Rotterdam, Netherlands;* [4] *La Trobe Univ., Melbourne, Australia*

Purpose: The patellofemoral joint (PFJ) is the most commonly affected compartment in knee osteoarthritis (OA), with estimates of isolated radiographic patellofemoral OA (PFOA) occurring in 40% of the population. Radiography is currently the most widely used imaging modality in OA evaluation and management, and the only modality accepted by the FDA for assessment of OA structural change. Despite this, a variety of radiographic techniques are used to image the PFJ and no consensus exists on how to grade radiographic features of PFOA. Standardized methods of acquiring PFJ radiographs have yet to be adopted, resulting in variances in patient positioning, weight-bearing status, flexion angle, and beam direction. Furthermore, the literature is characterized by multiple radiographic grading systems used to assess PFOA, and a consensus on optimal radiographic measures and thresholds for PFJ alignment has yet to be reached. The objectives of this systematic review were to: 1) provide an overview of contemporary methods of acquiring radiographs of the PFJ; 2) describe current methods of radiographic grading of PFOA; and 3) summarize PFJ alignment and bony morphology measures as identified on radiography.

Methods: The methods of this systematic review were developed in accordance with PRISMA guidelines and prospectively registered on PROSPERO (registration number: CRD42019115210). Electronic searches of PubMed, CiNAHL, SPORTDiscus, SCOPUS, EMBASE, PsycInfo, Cochrane Central Register of Controlled Trials (CENTRAL), and Web of Science were conducted from January 2000 to January 2019. Keywords related to the concepts of 'patellofemoral' and 'radiograph' were used to form the search. Records identified by the search strategy were screened for eligibility by two independent assessors using Covidence software. Primary studies describing radiographic acquisition methods of the anterior knee were included. Studies of non-human subjects or pediatric populations, cadaver studies, and single-subject studies were excluded.

Results: The search strategy yielded 18,678 unique records, with 1,526 papers included after full-text review. In order to report on the most recent literature, we agreed to limit data extraction to articles published since January 1, 2014. Thus, 528 articles were included. Articles represented 40 countries covering 6 continents, with data collected in clinical (58.3%) and research (41.7%) settings. A total of 68,637 participants (59.2% female) with a mean age of 46.7 years were evaluated. Nine medical disciplines were represented, with orthopedics accounting for 87.3% of articles. Four primary radiographic views were reported (coronal, sagittal, patellar, long-leg alignment). Of the 66.3% of articles reporting patellar radiograph acquisition, skyline (40.3%) and Merchant (31.4%) views were the most common, with 11 other methods described. Furthermore, considerable variations of the technique used to acquire radiographs were described for each method. For example, Merchant views were acquired in weight-bearing positions (23.1%), non-weight bearing positions (53.8%), or both (23.1%). The reported knee flexion angle for Merchant views was typically 45° (75.5%), but four other flexion angles were also reported, with 30° being reported by 21.8% of papers. Radiographic grading of PFOA was mentioned in 33% of articles. Kellgren-Lawrence (42.6%), Iwano (16.1%), and OARSI (10.3%) classification systems were most commonly used, although a total of 30 scoring methods were reported. Radiographic PFJ alignment and bony morphology measures were reported in 68.9% of articles. Of those measures reported, patellar height (61%), patellar tilt angle (28%), and mechanical axis (23.4%) were most commonly acquired.

		Africa	Asia	Australia	Europe	North America	South America	Multi-Continental	Total
Radiographic views acquired	Sagittal	6 (100%)	118 (79.7%)	17 (63%)	193 (87.7%)	98 (85.2%)	10 (90.9%)	1 (100%)	**443 (83.9%)**
	Patellar	3 (50%)	108 (73%)	19 (70.4%)	148 (67.3%)	66 (57.4%)	5 (45.5%)	1 (100%)	**350 (66.3%)**
	Coronal	3 (50%)	100 (67.6%)	20 (74.1%)	147 (66.8%)	65 (56.5%)	5 (45.5%)	1 (100%)	**341 (64.6%)**
	Long-Leg Alignment	3 (50%)	37 (25%)	1 (3.7%)	46 (20.9%)	18 (15.7%)	2 (18.2%)	0 (0%)	**107 (20.3%)**
PFOA grading reported		2 (33.3%)	34 (23%)	20 (74.1%)	82 (37.3%)	33 (28.7%	2 (18.2%)	1 (100%)	**174 (33%)**
PFJ morphology/alignment reported		5 (83.3%)	116 (78.4%)	12 (44.4%)	143 (65%)	79 (68.7%)	9 (81.8%)	0 (0%)	**364 (68.9%)**
Article Total		6 (100%)	148 (100%)	27 (100%)	220 (100%)	115 (100%)	11 (100%)	1 (100%)	**528 (100%)**



Conclusions: Our findings highlight substantial differences in PFJ radiographic acquisition and OA scoring methods in contemporary published literature. The current inconsistency and lack of standardization in radiographic acquisition methods may have an effect on prevalence estimates or disease severity assessment in both clinical and research settings. Clear guidelines for clinicians and researchers are needed to ensure consistency in the way that PFJ radiographs are acquired and graded for OA.

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MEDIAL MENISCUS EXTRUSION (MME) IS ASSOCIATED WITH TIBIAL OSTEOPHYTE WIDTH IN ELDERLY POPULATIONS -THE BUNKYO HEALTH STUDY

Y. Negishi [1], M. Ishijima [1,2], H. Kaneko [1], T. Aoki [2], L. Liu [1], H. Arita [1], M. Momoeda [1], A. Arepati [1], X. Ji [2], H. Huang [1,2], Y. Someya [2], Y. Tamura [2,3], Y. Watada [2,3], R. Kawamori [2,3], K. Kaneko [1,2]. [1] *Dept. of Med. for Orthopaedics and Motor Organ, Juntendo Univ. Graduate Sch. of Med., Bunkyo-ku,Tokyo, Japan;* [2] *Sportology Ctr., Juntendo Univ. Graduate Sch. of Med., Bunkyo-ku,Tokyo, Japan;* [3] *Dept. of Metabolism & Endocrinology, Juntendo Univ. Graduate Sch. of Med, Bunkyo-ku,Tokyo, Japan*

Purpose: Medial meniscus extrusion (MME) has been suggested to increase the risk of not only cartilage damage but also meniscus damage. However, the developmental mechanism of MME is still unclear. A population based observational study, in which 710 people aged >50 years of age (62.3 years of age in average) who had no radiographic evidence of knee OA [Kellgren-Lawrence(KL) grade 0] and who underwent MRI of the knee, showed that the prevalence of any abnormality on MRI was 89% overall and osteophytes, but not cartilage damages, were the most common abnormality (74%) among all participants (BMJ 2012). As osteophyte is formed in the similar process which is observed in an endochondral ossification, it is composed of not only bone part but also cartilage part at the peripheries of the articular cartilage. In our recent study using T2 mapping MRI, MME was found in all patients with early stage knee OA who did not have meniscal lesion or tear. We also demonstrated that osteophyte was also found in all cases. When cartilage-part of osteophyte was evaluated in addition to bone-part of osteophyte, MME was coincided with the medial tibial osteophyte width in patients with early stage knee OA (Arthritis Res Ther, 19:201, 2017). However, as this study involved in only 50 patients with early stage knee OA who needed treatment, we need to confirm this knowledge. In the present study, we examined the MRI-detected OA structural changes those associated with MME in healthy elderly peoples.

Methods: A total of 1,630 subjects aged between 65 to 84 years of age participated in the Bunkyo Health Study during from November 2015 to September 2018. A written informed consent was obtained all participants of this study. 1,191 among 1,630 subjects (56.6% females, 72.9 years of age on average) underwent both the plain radiograph in the standing position and MRI on knee joint. A radiographic severity of knee OA was classified into four grades using the Kellgren-Lawrence (K/L) classification. MME and the other knee OA structural changes were evaluated by MRI according to whole organ magnetic resonance imaging score (WORMS). The relationship between MME and other knee OA structural changes was analyzed using Spearman's rank correlation analysis and multiple regression analysis. In addition, the consistency between MME and the medial tibial osteophyte width was also analyzed. All analyses were undertaken using the statistical package SPSS.

Results: The severity of radiographic medial knee OA of the subjects in the present study was 16 (1.3%) for K/L 1, 1,025 (86.1%) for K/L 2, 112 (9.4%)