REV BRAS REUMATOL. 2016;xxx(xx):xxx–xxx

SOCIEDADE BRASILEIRA DE REUMATOLOGIA

REVISTA BRASILEIRA DE REUMATOLOGIA

www.reumatologia.com.br

Original article

Fixed-flexion knee radiography using a new positioning device produced highly repeatable measurements of joint space width: ELSA-Brasil Musculoskeletal Study (ELSA-Brasil MSK)

Rosa Weiss Telles, Luciana Costa-Silva, Luciana A.C. Machado, Rodrigo Citton Padilha dos Reis, Sandhi Maria Barreto*

Universidade Federal de Minas Gerais, Centro de Pesquisa ELSA-Brasil, Faculdade de Medicina, Belo Horizonte, MG, Brazil

ARTICLE INFO

Article history:
Received 18 November 2015
Accepted 21 October 2016
Available online xxx

Keywords:
Fixed-flexion radiography
Joint space width
Repeatability
Knee
Osteoarthritis

ABSTRACT

Objective: To describe the performance of a non-fluoroscopic fixed-flexion PA radiographic protocol with a new positioning device, developed for the assessment of knee osteoarthritis (OA) in Brazilian Longitudinal Study of Adult Health Musculoskeletal Study (ELSA-Brasil MSK).

Material and methods: A test–retest design including 19 adults (38 knee images) was conducted. Feasibility of the radiographic protocol was assessed by image quality parameters and presence of radioanatomic alignment according to intermargin distance (IMD) values. Repeatability was assessed for IMD and joint space width (JSW) measured at three different locations.

Results: Approximately 90% of knee images presented excellent quality. Frequencies of nearly perfect radioanatomic alignment (IMD $\leq$1 mm) ranged from 29% to 50%, and satisfactory alignment was found in up to 71% and 76% of the images (IMD $\leq$1.5 mm and $\leq$1.7 mm, respectively). Repeatability analyses yielded the following results: IMD [SD of mean difference = 1.08; coefficient of variation (%CV) = 54.68%; intraclass correlation coefficient (ICC) (95%CI) = 0.59 (0.34–0.77)]; JSW [SD of mean difference = 0.34–0.61; %CV = 4.48%–9.80%; ICC (95%CI) = 0.74 (0.55–0.85)–0.94 (0.87–0.97)]. Adequately reproducible measurements of IMD and JSW were found in 68% and 87% of the images, respectively.

Conclusions: Despite the difficulty in achieving consistent radioanatomic alignment between subsequent radiographs in terms of IMD, the protocol produced highly repeatable JSW measurements when these were taken at midpoint and 10 mm from the medial extremity of the medial tibial plateau. Therefore, measurements of JSW at these locations can be considered adequate for the assessment of knee OA in ELSA-Brasil MSK.

* *Corresponding author.*
E-mail: rwtelles@uol.com.br (R.W. Telles).

http://dx.doi.org/10.1016/j.rbre.2016.11.010

Please cite this article in press as: Telles RW, et al. Fixed-flexion knee radiography using a new positioning device produced highly repeatable measurements of joint space width: ELSA-Brasil Musculoskeletal Study (ELSA-Brasil MSK). Rev Bras Reumatol. 2016. http://dx.doi.org/10.1016/j.rbre.2016.11.010

A radiografia do joelho em flexão fixa utilizando um novo posicionador produziu medidas da largura do espaço articular com alta repetibilidade: estudo Elsa-Brasil Musculoesquelético (Elsa-Brasil MSK)

Palavras-chave:
Radiografia em flexão fixa
Largura do espaço articular
Repetibilidade
Joelho
Osteoartrite

RESUMO

Objetivo: Descrever o desempenho de um protocolo radiográfico em flexão fixa sem fluoroscopia em incidência PA com um novo posicionador, desenvolvido para a avaliação da osteoartrite de joelho (OA) no estudo ELSA-Brasil MSK.

Material e métodos: Fez-se um estudo de teste e reteste que incluiu 19 adultos (38 imagens de joelho). A viabilidade do protocolo radiográfico foi avaliada por meio de parâmetros de qualidade da imagem e presença de alinhamento radioanatômico de acordo com as medidas da distância intermarginal (DIM). Avaliaram-se a repetibilidade dos valores de DIM e a espessura do espaço articular (EA) em três locais diferentes.

Resultados: Aproximadamente 90% das imagens de joelho apresentaram uma qualidade excelente. As frequências de imagens com alinhamento radioanatômico quase perfeito (DIM<1mm) variaram de 29% a 50%, e de alinhamento satisfatório (DIM<1,5mm e <1,7mm) de 71% a 76%, respectivamente. As análises de repetibilidade produziram os seguintes resultados: DIM [DP da média das diferenças = 1,08; coeficiente de variação (% CV) = 54,68%; coeficiente de correlação intraclasse (CCI) (IC 95%) = 0,59 (0,34 a 0,77)]; EA [DP da média das diferenças = 0,34 a 0,61; % CV = 4,48% a 9,80%; CCI (IC 95%) = 0,74 (0,55 a 0,85) a 0,94 (0,87 a 0,97)]. Encontraram-se medidas adequadamente reprodutíveis de DIM e EA em 68% e 87% das imagens, respectivamente.

Conclusões: Apesar da dificuldade de obter um alinhamento radioanatômico consistente entre radiografias repetidas em termos de DIM, o protocolo produziu medições de LEA altamente repetíveis quando essas foram tomadas no ponto médio e a 10 mm da extremidade medial do platô tibial medial. Portanto, as medidas de LEA nesses locais podem ser consideradas adequadas para a avaliação da OA de joelho no estudo ELSA-Brasil MSK.

Introduction

Conventional knee radiography is the most widely accessible and least expensive imaging technique for the evaluation of osteoarthritic alterations in epidemiological studies with long-term follow-up.[1,2] Knee joint space narrowing (JSN), identified by reductions in joint space width (JSW) on serial knee radiographs, is considered an adequate proxy of cartilage damage and is frequently used as a marker for the progression of knee osteoarthritis (OA).[3,4]

The validity of inferences on the progression of knee OA based on JSN requires precise and reproducible measurements of JSW. This is generally achieved by specific radiographic techniques designed to facilitate optimal radioanatomic alignment between the medial tibial plateau (MTP) and the X-ray beam, and to expose the region where the cartilage damage is most noticeable (i.e., the posterior aspect of tibia and femoral condyle).[5]

The distance between the anterior and posterior margins of the MTP, known as intermargin distance (IMD), is often used to quantify radioanatomic alignment. Perfect alignment would be present when the MTP and the X-ray beam are parallel, what produces a superimposition of MTP margins on the radiographic image. Protocols that include fluoroscopic guidance are able to achieve a nearly perfect radioanatomic alignment, with IMD values ≤1 mm.[6] However, the implementation of fluoroscopic procedures is not straightforward in epidemiological studies because of the limited availability of fluoroscopy in non-specialized radiology services, higher costs, longer examination time, and a higher dose of ionizing radiation exposure.[7] On the other hand, the non-fluoroscopic fixed-flexion PA protocol is easier to implement and can produce acceptable radioanatomic alignment, with IMD values of up to 1.7 mm.[8] This protocol has also proved capable of providing reproducible JSW and IMD measurements.[3,9,10] Thus, it is not surprising that the non-fluoroscopic fixed-flexion PA protocol has been the radiographic method of choice in large cohorts investigating risk factors for the progression of knee OA, including the Multicenter Osteoarthritis Study – MOST (http://most.ucsf.edu/studyoverview.asp) and the Osteoarthritis Initiative – OAI (https://oai.epi-ucsf.org/datarelease). More recently, it was also chosen for the assessment of knee OA in the ELSA-Brasil Musculoskeletal Study (ELSA-Brasil MSK), which is an ancillary study of the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil) aiming to investigate risk factors for the development and progression of multiple musculoskeletal disorders.[11,12] Since 2012, ELSA-Brasil MSK has been monitoring a subcohort of approximately 2,900 public civil servants, aged between 38 and 79 years old [mean (SD) 56.0 (8.9)] at inception.[13]

ELSA-Brasil and its ancillary studies follow rigorous methodological procedures to ensure the quality of the

Please cite this article in press as: Telles RW, et al. Fixed-flexion knee radiography using a new positioning device produced highly repeatable measurements of joint space width: ELSA-Brasil Musculoskeletal Study (ELSA-Brasil MSK). Rev Bras Reumatol. 2016. http://dx.doi.org/10.1016/j.rbre.2016.11.010