The Utilization of POCUS as a Diagnostic and Classification Tool for Osteoarthritis

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INTRODUCTION

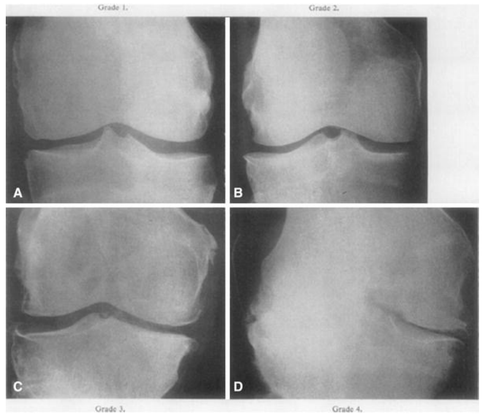
Osteoarthritis (OA) is, a polymorphic disease with a variety of clinical presentations, that is difficult to define.

Plain radiography remains a standard in the diagnosis of OA. It is one of the most common degenerative joint disease that affects a considerable number of people globally.

Despite the widespread use of radiography as an imaging tool, it has certain limitations that can be addressed by the implementation of newer modalities such point of care ultrasound.

HYPOTHESIS

Among patients presenting with suspected osteoarthritis, POCUS provides an equal or greater diagnostic accuracy compared to X-ray in detecting joint pathologies, such as joint space narrowing, bone spurs, and cartilage damage



AP radiographs of the knee presented in the original Kellgren-Lawrence article. (A) Representative knee radiograph of KL classification Grade 1, which demonstrates doubtful narrowing of the joint space with possible osteophyte formation. (B) Representative knee radiograph of KL classification Grade 2, which demonstrates possible narrowing of the joint space with definite osteophyte formation. (C) Representative knee radiograph of KL classification Grade 3, which demonstrates definite narrowing of joint space, moderate osteophyte formation, some sclerosis, and possible deformity of bony ends. (D) Representative knee radiograph of KL classification Grade 4, which demonstrates large osteophyte formation, severe narrowing of the joint space with marked sclerosis, and definite deformity of bone ends.
Reproduced from Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis.* 1957;16:494–502.

Kellgren-Lawrence Scale

The Kellgren-Lawrence (K-L) classification system is a method of classifying the severity of osteoarthritis (OA) using five grades. It was developed in 1957 by Harry Kellgren and Eric Lawrence, and is based on the radiographic appearance of OA in the hands, knees, hips, and spine.

The K-L system is based on the following four features:

- Joint space narrowing
- Osteophytes (bone spurs)
- Sclerosis (hardening) of the subchondral bone
- Deformity of the bone ends

Each feature is assigned a grade of 0 (absent) or 1 (present). The overall grade of OA is then determined by adding up the grades of the four features.

- Grade 0: No OA
- Grade 1: Mild OA
- Grade 2: Moderate OA
- Grade 3: Severe OA
- Grade 4: Very severe OA

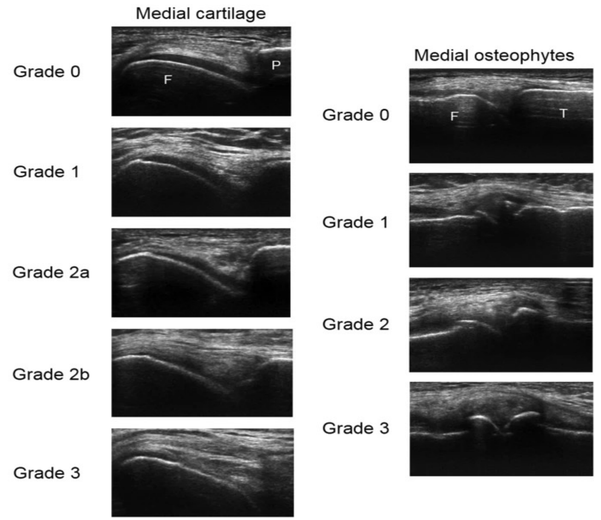
The K-L classification system is a useful tool for assessing the severity of OA and for tracking the progression of the disease over time. It is also used in research studies to compare the severity of OA in different populations.

Grade	Joint space narrowing	Osteophytes	Sclerosis	Deformity
0	Absent	Absent	Absent	Absent
1	Doubtful	Possible	Absent	Absent
2	Definite	Possible	Possible	Absent
3	Definite	Definite	Possible	Possible
4	Definite	Definite	Definite	Definite

Step-wise staging of OA by KL staging system.
Reproduced from Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. *Ann Rheum Dis.* 1957;16:494–502.

METHODS

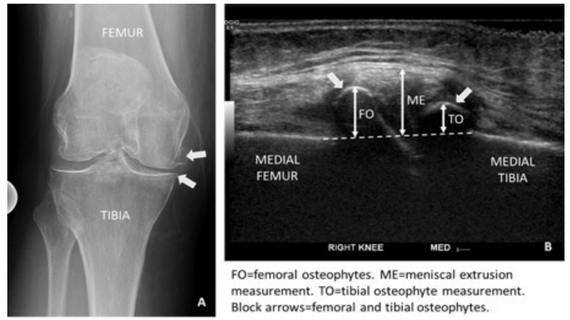
- Initially determine progression of OA through conventional X-ray use.
- Using POCUS retrieve image of Knee joint from anterior, lateral, and medial views.
- Use Kellgren-Lawrence classification system to grade joint space narrowing, osteophytes (bone spurs), sclerosis (hardening) of the subchondral bone , and deformity of the bone ends on a scale of 1-4.
- Compare and contrast diagnostic and classification results between POCUS and X-ray.



The definitions for articular cartilage degeneration grades assessed from transversal ultrasound images are as follows: Grade 0 – monotonous anechoic band with sharp hyperechoic anterior and posterior interfaces, Grade 1 – loss of the normal sharpness of cartilage interfaces and/or increased echogenicity of the cartilage, Grade 2a – in addition to the above changes, clear local thinning (less than 50%) of the cartilage, Grade 2b – Local thinning of the cartilage more than 50% but less than 100%, Grade 3–100% local loss of the cartilage tissue. The definitions for osteophyte grades assessed from longitudinal images are as follows: Grade 0 – no osteophyte, Grade 1 – small osteophyte, Grade 2 – medium osteophyte, Grade 3 – large osteophyte. In these images, the same grade osteophytes are always present on both femoral (F) and tibial (T) margin

FURTHER INVESTIGATION

- What are the sensitivity and specificity of POCUS and X-ray in detecting joint pathology in patients with suspected OA
- How does the diagnostic accuracy of POCUS and X-ray vary depending on the location and severity of the joint pathology?
- Are there any differences in diagnostic accuracy between POCUS and X-ray for specific joints commonly affected by OA, such as the knee, hip, and hand joints?
- What is the impact of patient factors, such as body habitus, joint anatomy, and comorbidities, on the diagnostic accuracy of POCUS and X-ray in detecting joint pathology?
- What is the cost-effectiveness of POCUS and X-ray in diagnosing OA, considering the costs of the imaging modality, follow-up testing, and treatment?



FO=femoral osteophytes. ME=meniscal extrusion measurement. TO=tibial osteophyte measurement. Block arrows=femoral and tibial osteophytes.

Radiograph of the right knee (A) with corresponding sonographic image of the medial knee (B) in end stage knee osteoarthritis. Measurement technique for femoral and tibial osteophyte and meniscal extrusion depicted.

STATISTICAL ANALYSIS

The study will be a randomized controlled trial that will compare the use of POCUS compared to conventional radiographic studies in classifying and diagnostic osteoarthritis.

The data acquired will be a combination of quantitative and qualitative data obtained from the Kellgren-Lawrence classification system and radiographic studies, respectively.

REFERENCES