

Radiography of the knee joint: A comparative study of the standing partial flexion PA projection and the standing fully extended AP projection using visual grading characteristics (VGC)



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ABSTRACT

Objectives: To compare the diagnostic information in detection and assessment of knee pathology from knee radiographs using either the PA standing with partial flexion projection or AP fully extended standing projection.

Method: A set of 32 knee radiographs was retrospectively compiled from 16 adult patients imaged using both projections over a 2-year period (PA: n = 16 and AP: n = 16). Repeat radiographs (n = 6) were added to the image set facilitating inter and intra observer reliability. Image evaluation was performed by 5 orthopaedic surgeons performing Absolute Visual Grading Analysis assessing image quality based on 6 anatomical image quality criteria specifically developed to evaluate and compare the two projections. The resulting image quality scores were analysed using Visual Grading Characteristics.

Results: Image quality scores were higher for the PA projection but variation between the two projections was not significant ($p > 0.05$). The PA projection was significantly ($p < 0.05$) better in the visualization of 2 anatomical image quality criteria involving the joint space width and tibial spines.

Conclusion: Both projections can be used for general evaluation of the knee joint, however the PA partial flexion projection is preferred for the investigation of specific knee pathology. Recommendations for minimizing variations in radiographic positioning technique are also highlighted.

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Introduction

The erect antero-posterior (AP) knee radiograph has been the standard imaging projection for knee radiography for over 30 years.¹ Over the past decade other projections such as the fixed-flexed postero-anterior (PA) standing projection have been utilized as a projection which may have a higher sensitivity and

specificity to detect joint space narrowing in the knee joint. There has not been a consensus agreement on which projection provides the best quality images as all of the projections have their limitations which include variation in the positioning of the patient.^{2,3}

Literature review

Weight-bearing radiographs taken in slight flexion reflect the width of the cartilage space most accurately as the major contact stresses in the tibiofemoral joint occur when the knee is in 24–28° flexion. Furthermore, cartilage loss mostly occurs in the posterior part of the femoral condyles and osteoarthritic erosions of these condyles mostly occur at a site which makes contact with the tibia at 30 degrees of flexion.⁴

Abbreviations: AP, anteroposterior; AUC, area under the curve; AUC_{VGC}, area under the visual grading characteristics curve; OA, osteoarthritis; PA, postero-anterior; VGA, visual grading analysis; VGC, visual grading characteristics; View-Dex, viewer for digital evaluation of x-ray images.

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Table 1
Anatomical criteria for knee radiographs.

Anatomical criteria for knee radiographs
1. Visually sharp reproduction of joint space width/narrowing
2. Visually sharp reproduction of position of the tibial spines relative to the femoral notch – centralized
3. Visually sharp reproduction of lateral compartment of the knee
4. Visually sharp reproduction of medial compartment of the knee
5. Visually sharp reproduction of mid-medial tibial plateau
6. Visually sharp reproduction of patella

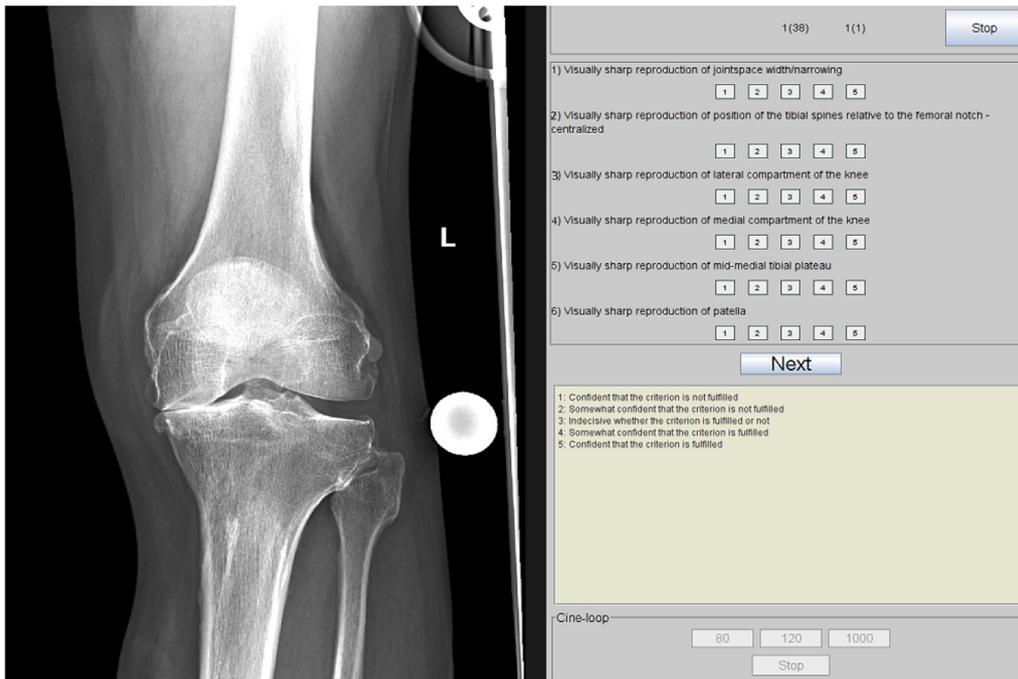


Figure 1. Screenshot of ViewDex 2.0.

Consequently, if the projection used is an AP extended projection, the cartilage space would still appear normal since most of the anterior cartilage is still well maintained. Although it should also be noted that increased flexion alone can result in apparent joint space loss of up to 25% in the medial compartment⁵ indicating that there is still disparity regarding the optimal knee flexion angle.⁶ That said, the sensitivity to detect narrowing of the joint space when using the fixed flexion PA is only slightly better when compared to the standard standing AP.¹ Therefore, the different projections would fulfil different criteria especially if looking for a range of pathologies and not just joint space narrowing in osteoarthritis (OA).

The purpose of this study was to compare the diagnostic information in detection and assessment of knee pathology from knee radiographs using either the PA standing with partial flexion projection or AP fully extended standing projection.

Method

In this study a retrospective approach was undertaken. X-ray images were randomly selected for review by orthopaedic surgeons. Ethical approval was sought and obtained to perform the study (Ref: UREC 21-6-2013).

Comparison of the AP and PA projections for All Observers

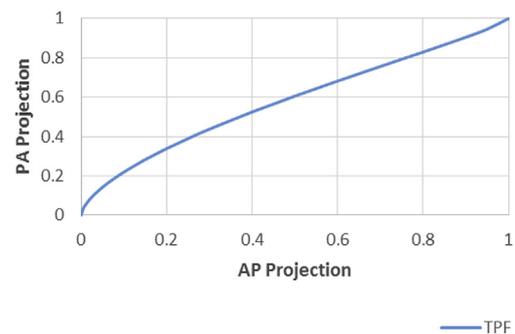


Figure 2. VGC Curve for the 5 observers combined comparing the AP Projection and the PA Projection of the knee. The resultant AUC_{VGC} is 0.583.

An image data set was compiled, consisting of 16 patients' images who had a knee X-ray performed on two occasions: once in the AP projection ($n = 16$) and a follow-up performed using the PA projection ($n = 16$) together with 3 images of each projection which were repeated to facilitate inter and intra rater reliability.

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