

Joint Line Position in Total Knee Arthroplasty: MRI Evaluation relative to tibial and femoral landmarks

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Introduction

Restoration of joint line position in complex primary and revision total knee arthroplasty requires the use of reference bony landmarks on both tibia and femur. We sought to combine previously established landmarks (fibular head, tibial tubercle and medial and lateral epicondyles) to assess tibiofemoral joint line position using magnetic resonance imaging of 'near normal' knees in patients under the age of 30 years.

Methods

A retrospective study was conducted. 104 consecutive patients were identified who underwent routine magnetic resonance imaging (MRI; 1.5T Magnetom, Symphony, Siemens) at a single center in London, UK. The joint line was determined from medial and lateral tibial plateau cartilages in specific best coronal slices and the perpendicular distance from the tip of fibular head measured and recorded (Fig. 1) [1]. In sagittal images the most proximal point of patellar tendon insertion into the tibial tubercle was identified and its perpendicular distance from the tibial plateau recorded (Fig. 2) [1]. On the femoral side, we used the medial epicondylar sulcus and the lateral epicondyle as bony landmarks for accurate determination of transepicondylar axis (TEPA) [2]. Intra- and inter-observer reliability were assessed using kappa coefficient. All the results were recorded and analyzed using Microsoft Excel (Microsoft, Washington, USA). Statistical values consisted of mean \pm standard deviation (SD) and correlation coefficients (r).

Results

The mean perpendicular distance from joint line to the most proximal part of the fibular head was 20.68 ± 2.42 mm (coronal MRI); from joint line to the most proximal insertion of the patellar tendon on the tibial tubercle was 22.04 ± 2.25 mm; from the transepicondylar axis (coronal MRI); to the most distal part of the medial femoral condyle articular cartilage was 22.37 ± 2.65 mm and lateral femoral condyle 19.30 ± 2.48 mm.

Discussion

The preservation of normal joint line position in knee arthroplasty is a fundamental requirement for good function. The femoral epicondyles, tibial insertion of patellar tendon and fibular head are regarded as stable anatomical landmarks in revision knee arthroplasty and have been used as reference points from which joint line can be restored [1,2]. This is the first study examining all of these landmarks simultaneously from one imaging modality.

This is the first study to utilize MRI to determine joint line level from both femoral and tibial landmarks. Our results should be of use when planning joint line restoration during complex primary and revision knee arthroplasty in the presence of deficient bone stock.

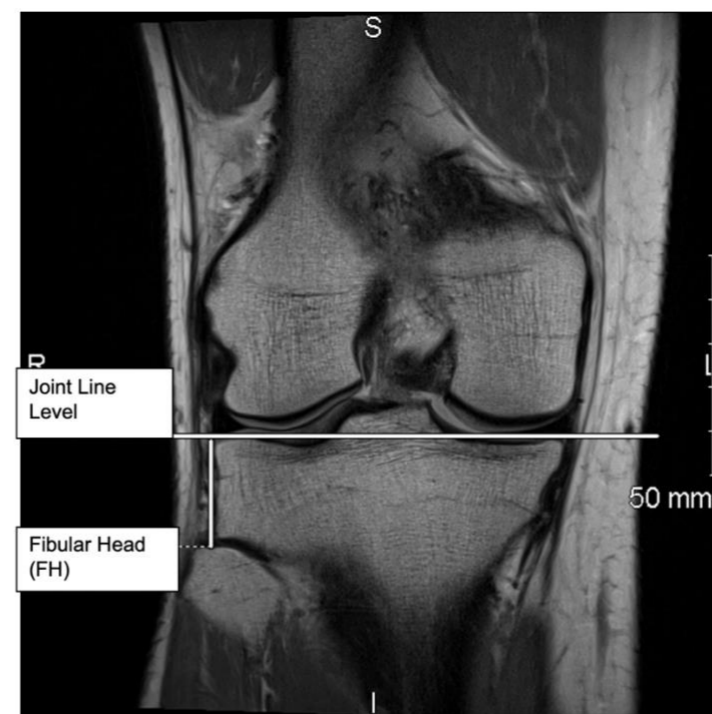


Fig. 1: Measurement of the distance between the tibial articular surface and the highest point of the fibular head in coronal MRI. The articular surfaces of tibial plateau was reference for joint line level as used in previous studies [3].

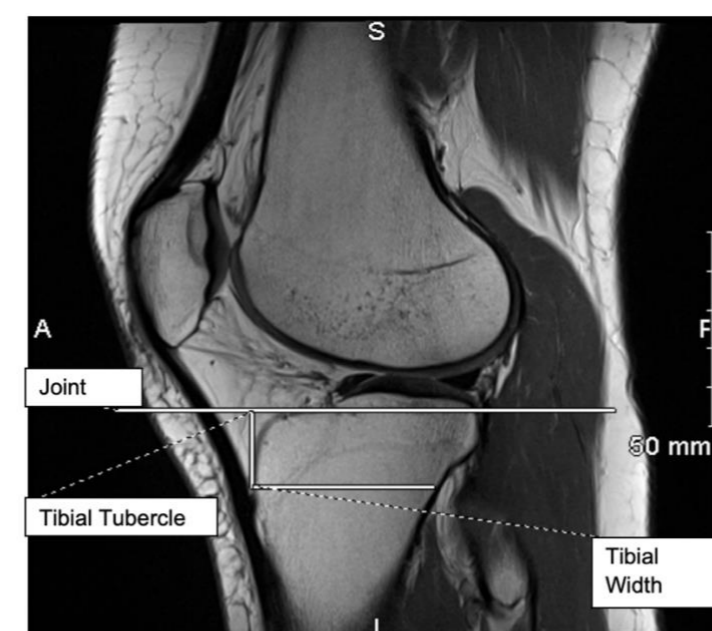


Fig. 2: Measurement of the distance between the joint line and the tibial tubercle at the site of most proximal insertion of patellar tendon in sagittal images. At the same time the anteroposterior tibial width is estimated from the same site of patellar tendon insertion. Again the articular surfaces of tibial plateau was reference for joint line level as used in previous studies [3].

Measurement	Total (n = 104) \pm SD	Male (n = 66) \pm SD	Female (n = 38) \pm SD
TT	22.0 \pm 2.3	22.8 \pm 2.1	20.8 \pm 2.0
TIW	44.9 \pm 4.7	46.7 \pm 3.8	41.3 \pm 3.7
FH	20.7 \pm 2.4	21.3 \pm 2.4	19.7 \pm 2.2
TT/TIW	49.0% \pm 5.0%	48.7% \pm 4.5%	50.4% \pm 4.8%
FH/TIW	46.0% \pm 5.4%	45.5% \pm 5.0%	47.7% \pm 5.4%
TEPA	78.7 \pm 5.9	82.4 \pm 3.4	72.5 \pm 3.6
MEC	22.4 \pm 2.7	22.3 \pm 2.4	22.1 \pm 3.0
LAC	19.3 \pm 2.5	19.7 \pm 2.6	18.6 \pm 2.3
MEC/TEPA	28.4% \pm 3.4%	27.0% \pm 2.9%	30.6% \pm 4.2%
LAC/TEPA	24.5% \pm 3.1%	23.9% \pm 3.1%	25.7% \pm 3.2%