

## Radiographical definition of the proximal tibiofibular joint – A cross-sectional study of 2984 knees and literature review



Hwee Weng Dennis Hey<sup>a,\*</sup>, Li Wen Nathaniel Ng<sup>a</sup>, Yau Hong Ng<sup>a</sup>,  
Wei Zhong Jonathan Sng<sup>b</sup>, Ruben Manohara<sup>a</sup>, Joseph Shanthakumar Thambiah<sup>a</sup>

<sup>a</sup>Department of Orthopaedic Surgery National University Health System, Singapore

<sup>b</sup>Department of Diagnostic Imaging National University Health System, Singapore

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### ABSTRACT

**Background:** Proximal tibiofibular joint (PTFJ) injuries are not uncommon but relatively understudied. This study evaluates the effectiveness of 2 radiographic methods in assessing the integrity of the PTFJ. **Study design:** This is a cross-sectional study of 2984 consecutive patients with knee X-rays done in a single institution over a 4-month period. A total of 5968 knee X-rays were assessed using 2 methods—[1] The direction in which the fibula points to in relation to the lateral femoral epicondyle on anteroposterior view and Blumensaat line on lateral view. [2] The degree of tibiofibular overlap as percentage of widest portion of the fibula head. Sensitivity and specificity of these methods in diagnosing a disrupted PTFJ are calculated. Variables including quality of X-rays, weight-bearing status of AP views and degree of knee flexion on lateral views are also recorded. Univariate analysis was carried out to investigate the association between variables using chi-square test for nominal data and student t-test for continuous data.

**Results:** The fibula points towards the lateral femoral epicondyle on AP view in 94.4% of the patients and points towards the posterior half of the Blumensaat line on lateral view in 98.1% of the patients. Using this method, weight-bearing X-rays are significantly associated with the direction the fibula is pointing ( $p < 0.01$ ) on the AP view and the degree of knee flexion is associated with the direction the fibula is pointing ( $p < 0.01$ ) on the lateral view.

The AP tibiofibular overlap ranges from  $>0\%$  to  $<75\%$  in 94.1% of the patients and the lateral tibiofibular overlap ranges from  $>0\%$  to  $<75\%$  in 84.5% of the patients.

This method is associated with whether true orthogonal X-rays of the knees are taken ( $p = 0.048$ ).

**Conclusion:** The direction in which the fibula is pointing and the percentage of tibiofibular overlap are highly specific radiographic methods useful in defining the PTFJ. The first method requires a weight-bearing view on AP assessment and  $>20$  degrees of flexion on lateral assessment. True orthogonal AP and lateral views are required for the second method to be used.

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### Introduction

Multiple case reports of traumatic proximal tibiofibular joint (PTFJ) injuries in the literature suggest that this joint may be more commonly injured than was previously thought and should be thoroughly studied. Other pathologies which may affect the PTFJ such as tuberculous infections [1], osteoarthritis [2] and

rheumatoid disease [3], can also go under-diagnosed due to our lack of understanding of this joint, leading to disastrous outcomes [4].

While there have been earlier cadaveric anatomical and biomechanical studies elucidating the morphology and function of the joint, large clinical and radiographical studies of the joint are lacking. This greatly limits the capabilities of practicing doctors in diagnosing this condition. As a result, the authors of this study proposed and evaluated a set of radiographical parameters using a large series of X-rays of the knees. These parameters are designed to be simple, reproducible and potentially effective in diagnosing PTFJ injuries.

\* Corresponding author at: 1E Kent Ridge Road, NUHS Tower Block Level 11, Singapore 119228. Tel.: +65 67723305; fax: +65 67780420.

E-mail address: [dennis\\_hey@nuhs.edu.sg](mailto:dennis_hey@nuhs.edu.sg) (H.W.D. Hey).

## Methodology

### Materials and methods

This is a cross-sectional study conducted in a single institution with tertiary healthcare facilities and a level 1 trauma centre. Following Institutional Ethics Review Board approval, we retrospectively collected all knee X-rays performed over a continuous 4-month period in the entire hospital. This 4-month period was arbitrarily selected based on the 4 months within which a single case report of a PTFJ dislocation occurred in our institution and was subsequently published [5]. In terms of the inclusion criteria, knee X-rays were taken in all various clinical settings (electively or at the emergency department), and for various clinical indications deemed appropriate by the attending physicians in the entire hospital during this period. Using the above mentioned criteria, a total of 6632 knee X-rays were collected.

All radiographs were retrieved from the hospital's electronic database and independently reviewed by a consultant Orthopaedic Surgeon and a consultant Radiologist to determine their suitability for the study. In terms of exclusion criteria, knee X-rays with poor image quality, or features showing an immature knee joint as evidence by an opened proximal tibia physis are removed from the study. After this process, a remaining 5968 knee X-rays were subjected to radiographical measurements and statistical analyses. Pertinent data collected and analyzed along with these X-rays included patient age, gender, clinical setting and indications for X-rays, the weight bearing status of the knee during the anteroposterior (AP) radiographs, and the angle of knee flexion during lateral radiographs.

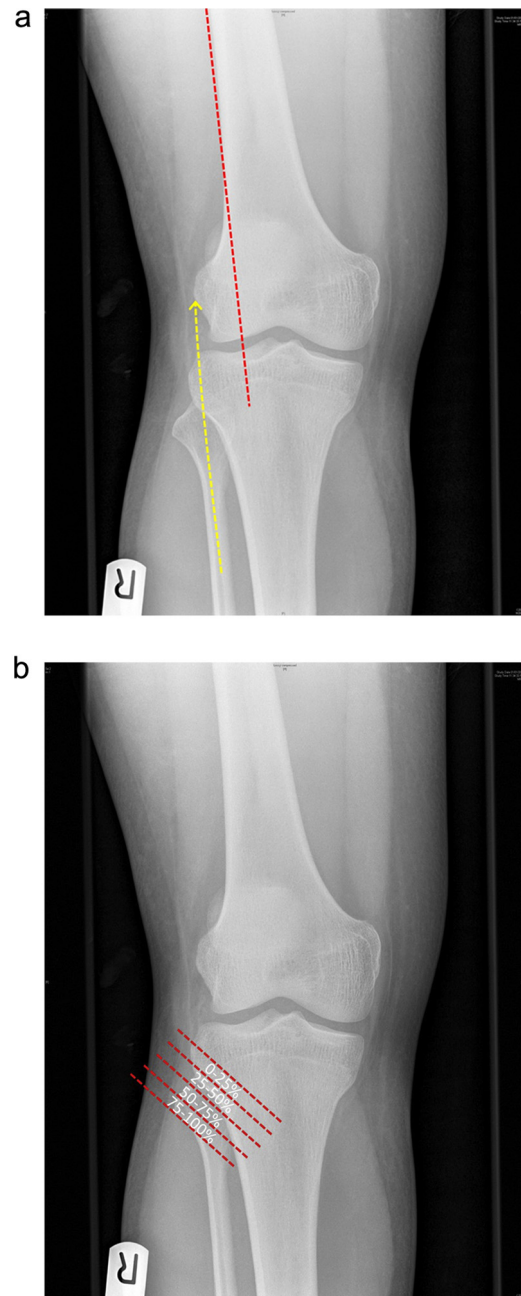
Any radiograph with more than 5% discrepancy in the measurement of any of the radiographic parameters between the 2 authors was re-evaluated and re-measured by another independent consultant Orthopaedic Surgeon.

### Radiographic assessment

All X-rays in the study conform to the institution's guidelines for performing knee X-rays. During the X-ray reviews, strict criteria were set to establish good quality control. A true AP view of the knee was defined as one where the anterior and posterior margins of the tibial plateau were superimposed on each other, and the tibial eminences were positioned in the centre of the medial and lateral femoral condyles [6]. A true lateral view of the knee was defined as one where the posterior margins of the medial and lateral femoral condyles were superimposed on each other. The quality of X-rays in terms of whether a true AP and lateral view of the knee is obtained is also recorded.

With emphasis placed on ease of usage, clinical feasibility and reproducibility, two methods of assessing the PTFJ radiographically were designed and applied to all AP and lateral knee X-rays (See Fig. 1a and b and Fig. 2 and b). The first method relates to the direction the fibula is pointing towards. On an AP view, it describes whether the fibula is pointing towards the lateral femoral epicondyle. On the lateral view, it describes whether the fibula is pointing towards the posterior half of the Blumensaat line. The second method relates to the percentage overlap between the proximal tibia and fibula on both the AP and lateral views. These measurements are expressed over a denominator of the fibular head width.

All radiographs were viewed using the Centricity Enterprise Web V3.0 software through a 19-inch LCD monitor, with a standardized aspect ratio of 16:9, resolution of 1920 × 1080 pixels and a 12-bit greyscale range. A digitally calibrated ruler was used to measure all the radiographic parameters, and a digital line trace



**Fig. 1.** (a) The fibula points to the lateral epicondyle of the femur, lateral or medial to it (b) The tibiofibular overlap is <25%, 25–50%, 50–70%, >75% of the entire fibula head.

was used to mark the linear axis of the fibula. Figs. 1 and 2 shows the proposed criteria that were used to determine if the PTFJ is normal on AP and lateral views respectively.

### Data analysis

All collected data was tabulated on Microsoft Excel Spreadsheet and statistical analyses were performed using the SPSS (version 17) software. The descriptive data on patient characteristics, clinical setting and indications for X-rays, the weight bearing status of the knee during the anteroposterior (AP) radiographs, and the angle of knee flexion during lateral radiographs were tabulated and expressed in proportions for nominal data and mean with standard deviations for continuous data.

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