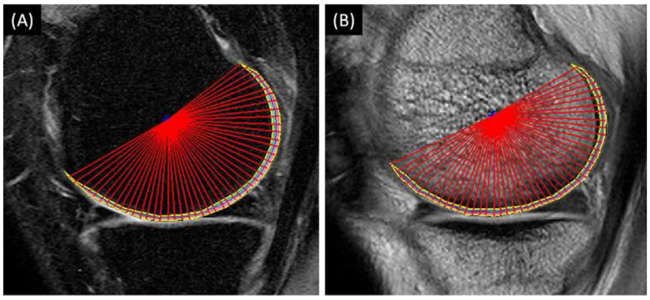

Figure 1. Sagittal images from T1rho sequence of knee MRI after manual segmentation with post-processing. (A) SPGR (B) b-FFE.

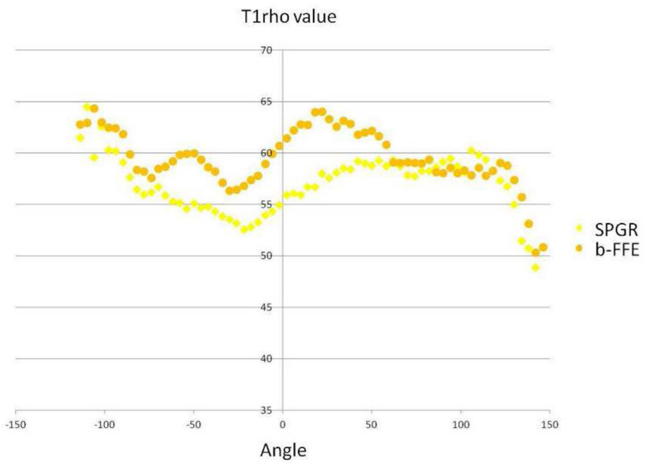

Figure 2. Comparison of T1rho value of entire knee cartilage between SPGR and b-FFE.

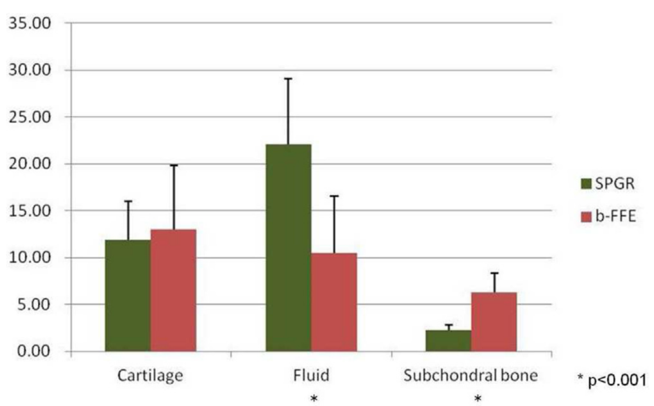

Figure 3. Mean values of relative signal intensity.

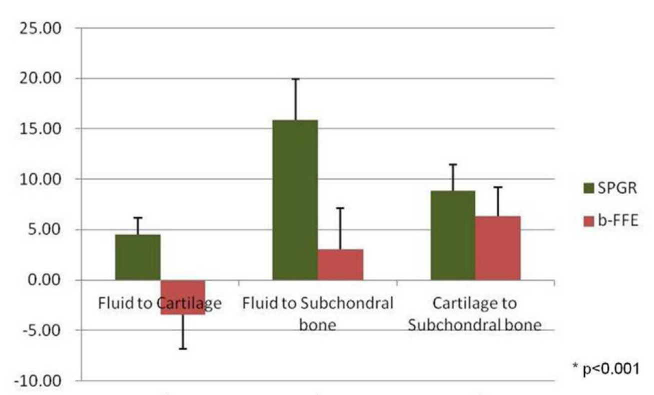

Figure 4. Mean values of relative contrast.

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TEST-RETEST RELIABILITY OF TIBIOFEMORAL JOINT SPACE WIDTH MEASUREMENTS USING LOW-DOSE STANDING CT

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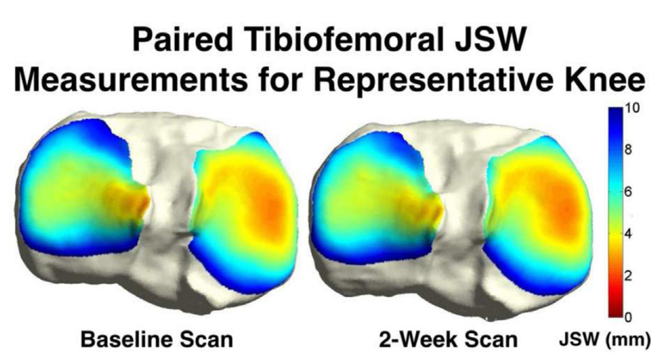
Purpose: Tibiofemoral joint space width (JSW), measured from plain radiographs, is the only structural outcome currently approved by the FDA for evaluating knee OA progression in clinical trials. While inexpensive and readily available, overlapping bony structures on 2D images make JSW measured from plain radiographs insensitive. This measure fails to detect changes in JSW for years after OA begins and requires > 3 years to detect progression. 3D images acquired using a low-dose standing CT (SCT) scanner are unencumbered by overlapping anatomy and may allow for more reliable JSW measurement, which would improve the monitoring of disease and speed the pace of scientific discovery. If found to be reliable, the proposed imaging procedure may become an attractive replacement for weight-bearing knee radiographs. Thus, our objective was to evaluate the test-retest reliability of SCT measurements of JSW.

Methods: Twenty-seven men and women, age 40 and older, with known KL grade 0-3 knees, chosen to represent a range of knee OA features, were recruited from the University of Iowa Hospitals and Clinics. Bilateral approximately 20° fixed-flexed SCT images of the tibiofemoral joint were acquired at visits two weeks apart. Tibial and femoral bone surfaces were extracted from the CT images using a semi-automated watershed transform-based algorithm implemented in MATLAB (The Mathworks, Natick, MA). A 3D triangulated surface mesh for each bone was generated and lightly smoothed to reduce voxellation artifact. Tibiofemoral JSW was quantified using a nearest-neighbor algorithm implemented in MATLAB. For each compartment, we defined the area for evaluation as that with a JSW < 10mm. The fractions of this area with JSW below thresholds between 2 and 5mm were calculated. JSW distributions for a representative knee scanned at baseline and 2 weeks later are depicted in the accompanying Figure. Test-retest reliability of the JSW measurements were assessed using Intraclass Correlation Coefficients (ICC 2,1) for the fractions below each threshold, using the Shrout-Fleiss fixed set method.

Results: Participants were 65.4% female (mean±SD age 58.2±11.3 years; BMI 29.1±5.6 kg/m^2). Four knees could not be segmented due to either lack of follow-up or movement during the scan on at least one visit. Therefore, 50 knees were included: 14 KL0, 5 KL1, 12 KL2 and 19 KL3 on

Test-Retest Reliability of 3D JSW By SCT

% Joint Area Below JSW (mm)	Lateral Compartment		Medial Compartment	
	ICC	ICC 95%CI	ICC	ICC 95%CI
5.0	0.97	0.94, 0.98	0.94	0.90, 0.97
4.5	0.97	0.94, 0.98	0.94	0.90, 0.96
4.0	0.95	0.92, 0.97	0.96	0.92, 0.97
3.5	0.95	0.91, 0.97	0.97	0.94, 0.98
3.0	0.97	0.94, 0.98	0.96	0.94, 0.98
2.5	0.97	0.94, 0.98	0.90	0.84, 0.94
2.0	0.97	0.95, 0.98	0.91	0.85, 0.95



pre-participation radiographs. Reliability results are presented in the accompanying Table.

Conclusions: The knee joint positioning protocol used demonstrated high day-to-day reliability for SCT 3D tibiofemoral JSW measurements in the medial and lateral compartments. Low-dose SCT provides a great deal more information about the morphology and distribution of JSW in the tibiofemoral joint while maintaining high reliability, making it a suitable alternative to plain radiographs for evaluating knee OA.

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DEVELOPMENT OF ASIAN HIP STEM 1 – THREE DIMENSIONAL MORPHOLOGY STUDY

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Purpose: Total hip arthroplasty (THA) has become common procedure for orthopaedic surgeons and it is used to restore the function of the hip joint lost to degenerative bone diseases such as osteoarthritis and rheumatoid arthritis. A morphology study was essential to the development of the cementless femoral stem because accurate dimensions for both the periosteal and endosteal canal ensure primary fixation stability for the stem – bone interface and prevent stress shielding at the calcar region. Conventional methods use two dimensional femur images from standard radiograph even though standard radiograph is imprecise compared to other medical imaging modalities such as computed tomography scanning and magnetic resonance imaging. This study focused on a three dimensional femoral model for Asian patients that applied pre-operative planning and femoral stem design. The diversity of the femoral size, particularly in the metaphyseal region allows for proper femoral stem design for Asian patients and improves osseointegration and prolongs the life of the implant.

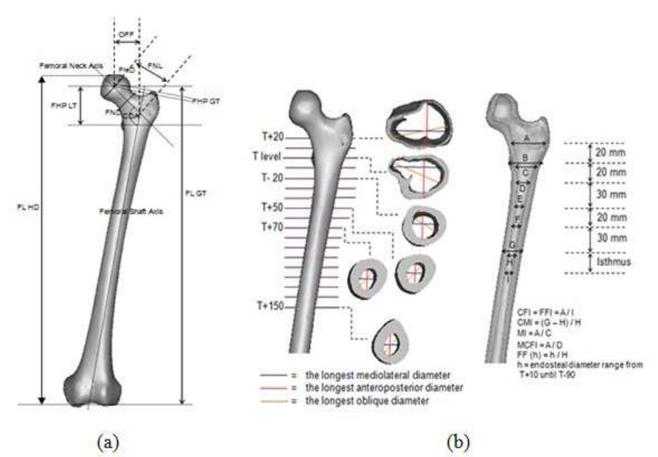

Figure 1. Morphology of 3D femora (a) Periosteal (b) Endosteal.

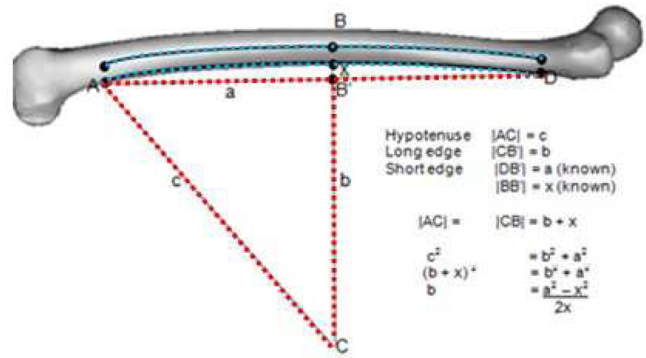

Figure 2. Measurement of anterior bowing from lateral view.

Methods: This prospective, cross-sectional study was carried out from January 2009 until December 2009 after obtaining approval from the National Medical Research Register (NMRR) and the local hospital ethics committee. We performed morphological studies of proximal femoral on 60 healthy femora. Computed tomography (CT) scans were performed using a four row multi slices CT scanner and were conducted using 120 kV and 90 mAs. The CT scan images in DICOM format were imported into Mimics 10.0 software. The CT image threshold in Hounsfield units (HU) was classified to demarcate boundary regions between the cortical bone and the cancellous bone through profile line checking across the CT gray slice section. The threshold profile was set to 662-1988 HU for cortical bone and 148-661 HU for cancellous bone. The femora mask was converted into a three dimensional model and then converted into a stereo lithography (STL) model and orthogonally cut into sections after measuring 10 mm intervals from the center of the lesser trochanter, T. The measurements data was statistically analyzed using SAS 4.3 software. The value $p<0.05$ was set to determine whether the data was statistically significantly.

Results: The comparison of periosteal femoral in different populations is depicted in Table 1. We compared our data to data from Thai, Indian, Nepalese, Caucasian, Turkish, and Swiss populations. The collo diaphyseal angle for Malays was higher (130.46∘) compared to other populations except Nepalese populations. However, due to the small physique of the Malay population, smaller sizes had been anticipated in several parameters such as femoral head offset, femoral neck length, and femoral head diameter. There was a 16.65 mm difference between Malay and Swiss populations in terms of femoral head offset, which is a crucial parameter for determining the size of the hip stem during preoperative planning. The anteversion and bowing angle for Malay populations were also different. The canal flare index (CFI) used in this study classified most of the samples as having a normal shape, which was in the range of 3.0-4.7.

Table 1
Comparison of the femoral periosteal morphology in different populations.

Parameters	Our Study (Malay) (n = 60)	Mahaisavariya et al. (Thai) (n = 108)	Rawal et al. (Indian) (n = 98)	Mishra et al. (Nepal) (n = 50)	Noble et al. (Caucasian) (n = 80)	Atilla et al. (Turkish) (n = 114)	Rubin et al. (Swiss) (n = 32)
Collo-diaphyseal angle (°)	130.46±4.02	128.04±6.14	124.42±5.49	132.60±8.36	125.40	128.40±4.75	122.90±5.76
Femoral head offset (mm)	30.35±4.26	-	40.23±4.85	-	-	42.70±6.54	47.00±7.20
Femoral neck length (mm)	45.30±4.74	46.22±5.14	48.40±5.66	-	-	-	-
Femoral head diameter (mm)	40.81±3.43	43.98±3.47	45.41±3.66	44.26±3.58	45.90	45.80±4.17	43.40±2.26
Femoral neck diameter (mm)	28.95±3.37	-	-	34.42±3.30	-	-	-
Femoral head position LT (mm)	53.14±4.87	48.94±4.95	52.33±3.19	-	-	59.10±7.74	56.10±8.20
Femoral head position GT (mm)	5.29±4.22	-	-	-	-	-	-
Anteversion (°)	19.10±8.67	11.37±7.65	10.90±4.22	15.41±5.21	10.00	-	-
Bowing angle (°)	2.28±1.19	5.75±1.37	8.15±2.08	-	9.00	-	-
Anterior bowing (mm)	1123.72±234.83	-	-	-	-	-	-
Canal flare index	4.65±0.83	-	4.23±2.97	-	-	-	3.36±0.75