

Computed Tomography Imaging of the Knee Compared to Dual X-Ray Absorptiometry for Opportunistic Osteopenia and Osteoporosis Screening in Patients Over Age 50: A Diagnostic Accuracy Study

Craig Klinger, MPH; Joseph Nguyen, MPH; Douglas N. Mintz; Kathryn Barth, MD; Lauren E. Mount; Rulla M. Tamimi; Elizabeth Gausden, MD; William M. Ricci, MD; Ashley Weaver, PhD; Derek Hansen, MD

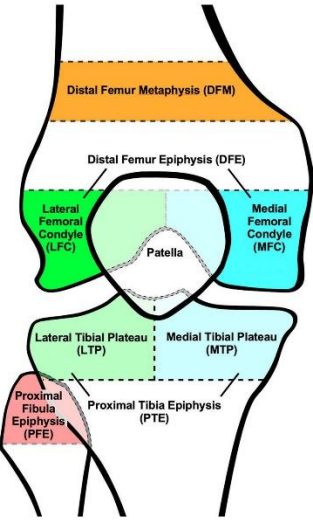
Purpose: Bone mineral density (BMD) assessment with computed tomography (CT) imaging can be used to expand screening using Hounsfield Unit (HU) analysis. This study aimed to determine the diagnostic accuracy of knee-CT HUs for osteopenia and osteoporosis in a consecutive institutional cohort.

Methods: An electronic health record search (Epic) was conducted for patients with both non-contrast knee-CT acquired at 120 kilovoltage peak (kVp) energy and dual x-ray absorptiometry (DXA) including hip and lumbar spine, performed within one-year of each other. Individuals with ipsilateral femur or tibia fractures or surgical histories, knee cartilage or bone lesions, or known metabolic bone disorders were excluded. DXA T-scores of the hips and lumbar spine were collected. Mean trabecular bone HUs were measured using Sectra-IDS7 PACS on three consecutive axial knee-CT slices for nine regions within the femur, tibia, patella, and fibula (Table 1).

Results: 126 cases met eligibility (mean age 68.7, SD±9.1; 104 females). On central-DXA (hips, lumbar spine) 15.1% patients had normal BMD, 46.8% osteopenia, and 38.1% osteoporosis. Good diagnostic accuracy (area under the curve, AUC: 0.8–0.9) was found for seven CT regions versus central-DXA T-scores for osteopenia and osteoporosis (e.g., proximal tibia epiphysis: AUC=0.860 and AUC=0.842, respectively); (Table 1).

Conclusions: Knee-CT had good diagnostic accuracy for osteopenia and osteoporosis. Opportunistic screening with CT can expand BMD assessment, adding diagnostic value to CT obtained for other clinical purposes.

Table 1. Diagnostic accuracy of knee CT-derived Hounsfield Units versus central DXA T-scores.



CT HU Region	HUC	AUC	p-value	95% CI Bound		YI	Sensitivity	Specificity	PPV	NPV
				Lower	Upper					
Osteopenia										
1 Distal femur metaphysis	142.833	0.857	<.001	0.769	0.944	0.592	88.7%	70.6%	94.5%	52.2%
2 Distal femur epiphysis	209.667	0.864	<.001	0.782	0.947	0.565	77.6%	78.9%	95.4%	38.5%
3 Medial femoral condyle	198.500	0.861	<.001	0.774	0.948	0.603	81.3%	78.9%	95.6%	42.9%
4 Lateral femoral condyle	237.333	0.858	<.001	0.774	0.942	0.541	80.4%	73.7%	94.5%	40.0%
5 Patella	252.000	0.738	<.001	0.608	0.869	0.453	66.4%	78.9%	94.7%	29.4%
6 Proximal tibia epiphysis	145.667	0.860	<.001	0.762	0.958	0.649	82.5%	82.4%	96.6%	43.8%
7 Medial tibial plateau	180.667	0.848	<.001	0.738	0.957	0.688	86.4%	82.4%	96.7%	50.0%
8 Lateral tibial plateau	112.022	0.864	<.001	0.787	0.941	0.611	72.8%	88.2%	97.4%	34.9%
9 Proximal fibula epiphysis	79.115	0.781	<.001	0.670	0.891	0.517	58.0%	93.7%	98.1%	28.8%
Osteoporosis										
1 Distal femur metaphysis	92.157	0.788	<.001	0.698	0.877	0.537	86.0%	67.6%	61.7%	88.9%
2 Distal femur epiphysis	163.667	0.857	<.001	0.789	0.924	0.587	79.2%	79.5%	70.4%	86.1%
3 Medial femoral condyle	137.000	0.819	<.001	0.743	0.896	0.497	68.8%	80.8%	68.8%	80.8%
4 Lateral femoral condyle	176.500	0.868	<.001	0.804	0.932	0.593	70.8%	88.5%	79.1%	83.1%
5 Patella	220.000	0.788	<.001	0.707	0.869	0.478	70.8%	76.9%	65.4%	81.1%
6 Proximal tibia epiphysis	100.772	0.842	<.001	0.774	0.911	0.541	78.7%	75.3%	67.3%	84.6%
7 Medial tibial plateau	116.333	0.815	<.001	0.739	0.891	0.504	72.3%	78.1%	68.0%	81.4%
8 Lateral tibial plateau	77.517	0.864	<.001	0.800	0.928	0.539	74.5%	79.5%	70.0%	82.9%
9 Proximal fibula epiphysis	73.207	0.818	<.001	0.736	0.900	0.515	78.4%	73.1%	61.7%	86.0%

CT=Computed Tomography, HU=Hounsfield Units, AUC=area under curve, CI=Confidence Interval, YI=Youden index, HUC=HU cutoff based on Youden index. PPV=positive predictive value. NPV=negative predictive value.