Utility of Preoperative of Bone Mineral Densitometry in Periprosthetic Fracture After Primary Total Knee Arthroplasty: A Propensity Matched Analysis

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INTRODUCTION: As the number of total knee arthroplasties (TKA) performed in the United States continues to rise, the incidence of postoperative periprosthetic fracture is expected to increase proportionally. Although relatively rare, with an incidence between 0.3% to 2.5%, periprosthetic fractures carry significant morbidity and mortality. Established risk factors include advanced age, anterior femoral notching, and reduced bone quality. Notably, patients with osteoporosis have nearly twice the risk of revision for periprosthetic fracture within five years after TKA. Previous studies have predominantly assessed bone mineral density (BMD) categorically, with limited evaluation of its relationship to fracture risk using T-scores obtained from dual-energy X-ray absorptiometry (DXA). The aim of this study was to evaluate the potential association between preoperative site-specific DXA T-scores and the risk of periprosthetic fracture following primary TKA.

METHODS: Following institutional review board approval, we conducted a retrospective review of 6,151 patients who underwent primary total knee arthroplasty (TKA) at a single academic institution. Inclusion criteria required a preoperative dual-energy X-ray absorptiometry (DXA) assessment for each anatomical site including lumbar spine, femoral neck, or total hip. Patients were categorized based on the occurrence of a postoperative periprosthetic fracture. To minimize confounding, cases were matched to controls in a 1:3 ratio using nearest-neighbor propensity score matching, with age, sex, body mass index (BMI), comorbidities, method of fixation and medication use as covariates. For each DXA site, mean T-scores were compared between groups using independent-samples *t*-test. Multivariable logistic regression was performed to evaluate the association between site-specific T-scores and the risk of periprosthetic fracture, adjusting for confounding variables.

RESULTS SECTION: Of the 6,151 patients included 114 (1.9%) patients had a postoperative periprosthetic fracture and 6,037 (98.1%) did not have a fracture. Propensity score matching yielded 114 patients with a periprosthetic fracture and 342 matched controls without fracture for analysis. Mean T-scores were significantly lower in the fracture cohort at the total hip (−1.1 ± 1.0 vs −0.7 ± 1.1; p = 0.012) and femoral neck (−1.6 ± 0.9 vs −1.2 ± 1.1; p = 0.008), whereas lumbar spine T-scores did not differ significantly between groups (−0.6 ± 1.5 vs −0.4 ± 1.7; p = 0.731) (Table 1). On multivariable logistic regression, each unit decrease in T-score at the total hip and femoral neck was associated with a 41% (OR 1.41, 95% CI 1.14–1.75; p = 0.002) and 44% (OR 1.44, 95% CI 1.15–1.81; p = 0.002) increase in the odds of periprosthetic fracture, respectively (**Table 2**). Lumbar spine T-scores were not significantly associated with fracture risk (OR 1.05, 95% CI 0.91–1.22; p = 0.488) (**Table. 2).**

DISCUSSION: Lower preoperative T-scores at the total hip and femoral neck were independently associated with a substantially increased risk of periprosthetic fracture following primary TKA, with each unit decrease corresponding to a 41% and 44% higher risk, respectively. In contrast, lumbar spine T-scores were not significantly associated with fracture risk. These results align with prior studies demonstrating a relationship with lower hip and femoral neck bone mineral density have a higher cumulative incidence of periprosthetic fractures after TKA, reinforcing the importance of targeted bone health assessment. Incorporating femoral neck and total hip DXA measurements into preoperative evaluation may facilitate identification of high-risk patients and guide surgical planning, including implant selection and fixation strategy, to mitigate fracture risk.

SIGNIFICANCE/CLINICAL RELEVANCE: DXA measurements provide preoperative information that can be utilized for perioperative planning and intraoperative decision-making to mitigate fracture risk in TKA patients.

DXA Measurement Site	Periprosthetic Fracture (mean ± SD) n = 114	Non-Periprosthetic Fracture (mean ± SD) n =342	p-value
Total Hip (n)	**100**	**332**	
T-Score	−1.1 ± 1.0	−0.7 ± 1.1	**0.012**
Femoral Neck (n)	**100**	**334**	
T-Score	−1.6 ± 0.9	−1.2 ± 1.1	**0.008**
Lumbar Spine (n)	**94**	**288**	
T-Score	−0.6 ± 1.5	−0.4 ± 1.7	0.731

Table 1. Comparison of mean T-Scores stratified by DXA measurement site between the periprosthetic fracture and non-periprosthetic fracture cohorts.

DXA Measurement Site	Adjusted OR (95% CI)	P-Value
Total Hip T-Score	1.41 (1.14–1.75)	**0.002**
Femoral Neck T-Score	1.44 (1.15–1.81)	**0.002**
Spine T-Score	1.05 (0.91–1.22)	0.488

Table 2. Association between site-specific DXA T-scores and risk of periprosthetic fracture following primary knee arthroplasty.