

## Utility of Preoperative Site-Specific Bone Mineral Densitometry in Periprosthetic Fracture After Primary Total Hip Arthroplasty: A Propensity Matched Analysis

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**INTRODUCTION:** Periprosthetic fracture (PPF) is an uncommon but serious complication of total hip arthroplasty (THA), occurring in up to 2.1% of patients. The incidence is expected to rise as THA volumes increase over the next decade. Recognized risk factors include age, sex, bone quality, and implant design, with previous studies demonstrating the protective effect of collared stems and cemented fixation. Most research has assessed bone health using clinical diagnoses of osteoporosis or osteopenia. Few studies have examined the role of site-specific bone mineral density measured by dual-energy X-ray absorptiometry (DXA) in periprosthetic fracture risk. Therefore, this study aims to investigate the potential association between preoperative DXA T-scores at different anatomical sites and the risk of periprosthetic fracture following primary THA.

**METHODS:** Following institutional review board approval, this retrospective study reviewed 4,154 consecutive patients who underwent primary total hip arthroplasty (THA) at a single tertiary academic medical center. Patients were included if a preoperative dual-energy X-ray absorptiometry (DXA) T-score was available for at least one site: total hip, femoral neck, or lumbar spine. Patients were categorized into two cohorts based on the occurrence of a postoperative periprosthetic fracture. A 1:3 nearest-neighbor propensity score match was performed using demographics, comorbidities, method of fixation, and medication use (bisphosphonates, glucocorticoids, teriparatide). Continuous variables were analyzed using independent-samples *t*-tests, and multivariable logistic regression was performed separately for each DXA site to assess the association between T-scores and periprosthetic fracture, reporting odds ratios (OR) per 1-unit decrease with 95% confidence intervals (CI).

**RESULTS SECTION:** Following 1:3 propensity score matching, 129 (3.1%) patients with periprosthetic fracture were compared with 387 (96.9%) without a fracture. The periprosthetic fracture cohort demonstrated significantly lower mean T-scores at the total hip ( $-1.4 \pm 1.0$  vs  $-0.9 \pm 1.0$ ;  $p < 0.001$ ) and femoral neck ( $-1.6 \pm 1.1$  vs  $-1.2 \pm 1.2$ ;  $p = 0.001$ ), whereas lumbar spine T-scores did not differ significantly ( $-0.8 \pm 1.4$  vs  $-0.5 \pm 1.7$ ;  $p = 0.063$ ) (**Table 1**). In multivariable logistic regression, each 1-unit decrease in T-score at the total hip (OR 1.63, 95% CI 1.30–2.06;  $p < 0.001$ ) and femoral neck (OR 1.37, 95% CI 1.11–1.69;  $p = 0.003$ ) was independently associated with higher odds of PPF, whereas lumbar spine T-score was not significantly associated (OR 1.14, 95% CI 0.99–1.30;  $p = 0.064$ ) (**Table 2**).

**DISCUSSION:** Periprosthetic fracture is a leading cause of readmission after total joint arthroplasty and the most common aseptic indication for revision within 90 days of the index procedure. Consistent with previous studies linking low bone mineral density to increased fracture risk, our matched analysis found that each unit decrease in T-score at the total hip and femoral neck was associated with 63% and 37% increase in fracture risk, respectively, whereas lumbar spine T-Score was not significantly associated. These findings highlight the value of site-specific bone density assessment in preoperative planning and support the integration of T-scores into risk stratification to identify high-risk patients and guide optimal surgical strategies.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Preoperative site-specific DXA measurements provide clinically useful information that can be utilized by arthroplasty surgeons in preoperative planning and intraoperative decision-making, including implant and fixation choice to mitigate periprosthetic fracture.

DXA Measurement Site	Periprosthetic Fracture (mean ± SD) n=129	Non-Fracture (mean ± SD) n= 387	p-value
<b>Total Hip (n)</b>	<b>102</b>	<b>344</b>	
<b>T-Score</b>	$-1.4 \pm 1.0$	$-0.9 \pm 1.0$	<b>&lt;0.001</b>
<b>Femoral Neck (n)</b>	<b>102</b>	<b>344</b>	
<b>T-Score</b>	$-1.6 \pm 1.1$	$-1.2 \pm 1.2$	<b>0.001</b>
<b>Lumbar Spine (n)</b>	<b>113</b>	<b>336</b>	
<b>T-Score</b>	$-0.8 \pm 1.4$	$-0.5 \pm 1.7$	0.063

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

DXA Measurement Site	OR (95% CI)	p-value
<b>Total Hip T-Score</b>	1.63 (1.30–2.06)	<b>&lt;0.001</b>
<b>Femoral Neck T-Score</b>	1.37 (1.11–1.69)	<b>0.003</b>
<b>Spine T-Score</b>	1.14 (0.99–1.30)	0.064

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