Osteoporosis is Underdiagnosed and Undertreated Following Surgical Fixation of Fragility Fractures

Madeleine Grace DeClercq[1,2], BS, Lauren Eberhardt[1,2], BS, Philip Zakko[1], MD, Jacob Keeley[2], MS,
Megan Audet[1], MD, Kaitlyn Whitney, BS, MPH, Daniel Park[1], MD
[1] Corewell Health, William Beaumont University Hospital, Department of Orthopedic Surgery, Royal Oak, MI, USA
[2] Oakland University William Beaumont School of Medicine, Rochester, MI, USA
madeleinedeclercqmd@gmail.com

INTRODUCTION: Vertebral Compression Fractures (VCF) and Femoral Neck fractures (FNF) are fragility fractures, defined as low energy trauma typically resulting from falls at standing height and are common in the elderly population. Despite widely available screening modalities, a majority of patients are not identified as having osteoporosis before having a fragility fracture. A late diagnosis increases the risk of a second fragility fracture, further increasing the risk of morbidity and mortality. Therefore, the purpose of this study was to (1) evaluate pre- and post-fracture medical management of osteoporosis among patients who underwent surgical fixation of femoral neck fractures (FNF) and vertebral compression fractures (VCF), (2) quantify the frequency of subsequent fragility fractures post-operatively and (3) investigate if there is a difference in treatment and management of osteoporosis between FNF and VCF patients. We hypothesize that there is no difference between VCF and FNF patients in the medical management of fragility fractures with respect to osteoporosis diagnosis, DEXA scans, pharmacologic treatment, or subsequent fractures in the preoperative period or at 2 years post-operatively.

METHODS: This study was approved by the Beaumont Health Institutional Review Board (IRB). Patients who underwent surgical fixation of FNF or VCF were retrospectively reviewed at a minimum 2 year follow up. Patients were excluded if their fracture was caused by high energy trauma or malignancy, <50 years-old, deceased, or lost to follow up. Patient demographics such as age, sex, BMI, American Society of Anesthesiology Physical Status Classification System and Charleston Comorbidity index were recorded. Management of osteoporosis, including medication regimen and dual-energy X-ray absorptiometry (DEXA) scans were assessed preoperatively and at one year follow up. Subsequent fractures were also recorded. To determine whether differences existed between two subsets of patients, t-tests and chi-squared analyses were used for continuous and categorical variables, respectively. When t-tests and chi-squared analyses were inappropriate, nonparametric alternatives were considered and employed when applicable. To control for confounding variables and to address potential sources of bias, univariable and multivariable analyses were performed.

RESULTS: 370 patients were included in this review. Postoperatively, there was no difference in new osteoporosis diagnosis between groups, administration of bisphosphonates, or subsequent fractures (p>0.05). However, VCF patients were more likely to be given denosumab and to undergo a DEXA scan in the post-operative period (p<0.05). In total, only 12.7% of patients received appropriate post-operative osteoporosis treatment, 27.1% of patients had ever received a DEXA scan, and only 25% of patients had a diagnosis of osteoporosis listed in their medical record. In univariable analysis, having a VCF was a predictive factor for getting a DEXA scan postop (p-value = 0.0314)). However, in multivariable analysis, having a VCF was a not predictive factor (p-value=0.0673). In multivariable analysis, having the diagnosis of osteoporosis before having fragility fracture was a significant predictor of the outcome of getting a DEXA scan post-operatively (p-value=0.0035) and for getting any anti-osteoporotic medication postoperatively (p-value=0.0022).

DISCUSSION: This review of 370 fragility fracture patients found that 74.9% of patients remained without an osteoporosis diagnosis listed in their medical record, and 87% of patients were not treated according to clinical practice guidelines. In order to minimize preventable risk, special attention must be given to patients with fragility fractures.

SIGNIFICANCE/CLINICAL RELEVANCE The study highlights that osteoporosis is under-diagnosed and under-treated in fragility fracture patients, despite advancements in fragility fracture liaison services and the American Orthopedic Association's "own the bone" initiative. We propose that patients who sustained a fragility fracture should be treated in line with the osteoporotic treatment guidelines set forth by the American Association of Clinical Endocrinology and urge orthopedic surgeons to take on this responsibility.

	FNF (N=276)	VCF (N=94)	Total (N=370)	P-value
Osteoporosis Diagnosis in chart, n (%)				0.1378[2]
Preoperative period	53 (19.2%)	27 (28.7%)	80 (21.6%)	
At or Within 1 Year	11 (4.0%)	2 (2.1%)	93 (25.1%)	
No Diagnosis	212 (76.8%)	65 (69.1%)	277 (74.9%)	
DEXA Scan				0.00081[3]
Never	211 (76.4%)	67 (71.3%)	278 (75.1%)	
Preoperative period	52 (18.8%)	23 (24.5%)	75 (20.3%)	
At or Within 1 Year	14 (5.1%)	11 (11.7%)	100 (1.6.1)	
Bisphosphonates				0.3322[3]
Never	258 (93.5%)	85 (90.4%)	343 (92.7%)	
Preoperative period	2 (0.7%)	2 (2.1%)	4 (1.1%)	
At or Within 1 Year	18 (6.5%)	8 (8.5%)	26 (7.0%)	
Denosumab				0.0068[3]
Never	270 (97.8%)	85 (90.4%)	355 (95.9%)	
Preoperative period	1 (0.4%)	1 (1.1%)	2 (0.5%)	
At or Within 1 Year	6 (2.2%)	9 (9.6%)	15 (4.1%)	
Alternative Medications*				0.7098[3]
Never	271 (98.2%)	93 (98.9%)	364 (98.4%)	
Preoperative period	2 (0.7%)	0 (0.0%)	2 (0.5%)	
At or Within 1 Year	5 (1.8%)	1 (1.1%)	6 (1.6%)	
Vitamin D and Calcium, n (%)				0.0329[3]
Never	253 (91.7%)	83 (88.3%)	336 (90.8%)	
Preoperative period	6 (2.2%)	7 (7.4%)	13 (3.5%)	
At or Within 1 Year	23 (8.4%)	9 (9.6%)	32 (8.7%)	
Vitamin D alone, n (%)				<.0001[2]
Never	149 (54.0%)	53 (56.4%)	202 (54.6%)	
Preoperative period	31 (11.3%)	27 (28.7%)	58 (15.7%)	
At or Within 1 Year	121 (44.0%)	36 (38.3%)	157 (42.5%)	
Calcium alone, n (%)				0.1090[3]
Never	253 (91.7%)	83 (88.3%)	336 (90.8%)	
Preoperative period	10 (3.6%)	6 (6.4%)	16 (4.3%)	
At or Within 1 Year	35 (12.7%)	13 (13.8%)	48 (13.0%)	

[1]Unequal variance two sample t-test; [2]Fisher Exact p-value; [3]Chi-Square p-value
*Alternative medications = estrogen, calcitonin, raloxifene, and teriparatide.

Table 1. Osteoporosis Workup, Diagnosis and Management in patients who were not previously diagnosed with osteoporosis
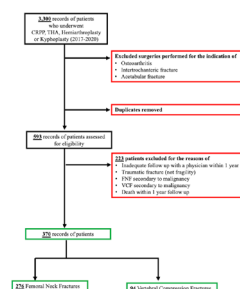

Figure 1. Flow chart of excluded and included patients with reasoning according to STROBE standards.

Table 2. Univariable and Multivariable regression analysis of independent and dependent variables with associated p-values, odds ratios and 95% confidence intervals.

Variables	Post-op DEXA Scan			Post-op Medications			Subsequent Fractures		
	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value	Odds Ratio	95% CI
VCF vs FNF									
Univariable	0.0314	2.480	(1.084-5.673)	0.0982	1.747	(0.902-3.385)	0.3666	0.601	(0.199-1.814)
Multivariable	0.0673	2.200	(0.945-5.118)	0.0929	1.830	(0.904-3.704)	0.3391	0.582	(0.192-1.766)
Osteoporosis diagnosed before fracture vs Not diagnosed before fracture									
Univariable	--	--	--	--	--	--	--	--	--
Multivariable	0.0035	3.478	(1.506-8.034)	0.0022	2.867	1.460-5.629	0.5236	1.372	(0.519-3.626)
1 Comorbidity vs No comorbidity									
Univariable	--	--	--	--	--	--	--	--	--
Multivariable	--	--	--	0.7423	1.163	0.473-2.863	--	--	--
2 Comorbidities vs No comorbidity									
Univariable	--	--	--	--	--	--	--	--	--
Multivariable	--	--	--	0.1814	1.833	0.754-4.459	--	--	--
3 Comorbidities vs No comorbidity									
Univariable	--	--	--	--	--	--	--	--	--
Multivariable	--	--	--	0.3832	0.639	0.233-1.749	--	--	--