

## **A 10-Year Experience of an Integrated Geriatric Hip Fracture Treatment Protocol: Outcomes at a Minimum 2-Year Follow Up**

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**INTRODUCTION:** Fragility hip fractures are associated with low-energy trauma in patients  $\geq 65$  years of age and place significant financial stress on the US healthcare system. Recent estimates show that the burden of care for fragility hip fractures in the US is 6 billion USD. Safe and effective protocols to treat fragility hip fractures and address bone health are paramount to reduce future fractures, while improving patient outcomes and controlling healthcare costs. While efforts have been made to create standardized protocols for the management of fragility hip fractures and subsequent evaluation of bone health and treatment of identified osteopenia or osteoporosis in these patients, institutional differences remain. Current literature shows that successful implementation of hip fracture protocols and pathways to address bone health can decrease all-cause mortality rates, lower healthcare facility admissions, and extend hospital-free survival time. Remarkable variability exists with respect to reported subsequent fractures rates. There are studies demonstrating a 40% reduction in future fractures, while other publications report no change. The purpose of this investigation was to evaluate our hip fracture treatment protocol implementation, compliance, and effect on subsequent fracture rates during the first decade of adoption for patients presenting to an integrated healthcare system with a minimum 2-year follow up after a hip fracture event.

### **METHODS:**

A retrospective review was performed to identify patients  $\geq 65$  who presented with fragility hip fractures to our system between 2010 and 2022 using relevant ICD-10 codes. Baseline demographic information such as age, sex, body mass index, race, tobacco use, marital status, and insurance status were collected. Patients who received a "High-Risk Osteoporosis Clinic" (HiROC) referral within 90 days of their fragility hip fracture comprised the HiROC (+) cohort. Patients without this referral constituted the HiROC (-) cohort. The HiROC medical consultants initiated a bone health evaluation which included patient history, pertinent medical information, laboratory testing, and bone density DEXA scans. Treatment plans were based on testing results and fracture risk stratification which included bisphosphonate medications as indicated. Similar to the nomenclature of the initial cohorts, patients completing additional steps of the protocol were further categorized into more granular groups. Patients with less than two years follow up were excluded. Additional fracture rates, anatomic site of subsequent fractures, and injury mechanisms were recorded and calculated for 4 cohorts: HiROC (-); HiROC (+) DEXA (-); HiROC (+) DEXA (+) MED (-); HiROC (+) DEXA (+) MED (+). An assessment of the protocol implementation and compliance over the first ten years was made using the identified cohorts and percentages of patients within each of the four treatment groups.

**RESULTS:** A total of 1,671 fragility hip fractures were identified. Three-hundred -eighty-six cases were excluded due to not having minimum two-years follow up. The average age of the patients was 81.6 years, and the median follow up was 36.4 months (24.2-51.1). Female patients comprised 75.6% (n=972) of the study population (p<0.04). Of the 1,285 included cases, 56% (n=720) had a HiROC referral placed. Patients with a HiROC referral had lower subsequent fracture rates at two years, compared to those without referral (28% vs. 13%, p<0.0001). When stratified by implementation of sequential steps of the HiROC protocol, patients completing more steps had lower subsequent fracture rates (28% vs. 15% vs. 13% vs. 5%, p<0.0001). No statistically significant difference was observed between the identified cohorts for anatomic site of subsequent fractures.

### **DISCUSSION AND CONCLUSION:**

Successful implementation of this geriatric hip fracture protocol was associated with reduced additional fractures at minimum two-years follow up. Patients completing more steps of the protocol had successively lower subsequent fracture rates following the initial hip fracture event. Identifying steps of process failures in the geriatric hip fracture protocol can provide opportunities for increased compliance and reduction in future fracture occurrences for captured patients.

	HiRoC (-)	HiRoC (+) DXA (-)	HiRoC (+) DXA (+) MED (-)	HiRoC (+) DXA (+) MED (+)	p-value
Included, n	565	305	397	18	N/A
Average age, years (SD)	81 (8.4)	82.1 (8.7)	82.4 (8.2)	76.7 (8.2)	0.34
BMI, average (SD)	25.1 (5.5)	25.2 (6)	25.9 (5.7)	26.5 (4.4)	0.79
Gender, n (%)					
Male	125 (21.8%)	70 (23%)	113 (28.5%)	7 (38.9%)	<b>0.04</b>
Female	442 (78.2%)	235 (77%)	284 (71.5%)	11 (61.1%)	
Race, n (%)					
White	560 (99.1%)	298 (97.7%)	387 (97.5%)	18 (100%)	0.16
Unable to obtain	3 (0.4%)	2 (0.7%)	3 (0.8%)	-	
American Indian/Alaska Native	-	1 (0.3%)	2 (0.5%)	-	
Black	2 (0.4%)	2 (0.7%)	4 (1%)	-	
Asian	-	1 (0.3%)	1 (0.3%)	-	
Tobacco use, n (%)					
Current	38 (6.7%)	20 (6.6%)	28 (7.1%)	1 (5.6%)	0.98
No	527 (93.3%)	285 (93.4%)	369 (92.9%)	17 (94.4%)	
Marital Status, n (%)					
Married	176 (31.2%)	92 (30.2%)	138 (34.8%)	4 (22.2%)	0.41
Single	389 (68.8%)	213 (69.8%)	259 (65.2%)	14 (77.8%)	
Insurance Status, n (%)					
Private (other than institutional)	41 (7.3%)	22 (7.2%)	19 (4.8%)	1 (5.6%)	<b>0.03</b>
Private (institutional)	15 (2.7%)	23 (7.5%)	20 (5%)	2 (11.1%)	
Medicare/Medicaid	312 (55.2%)	176 (57.7%)	246 (62%)	12 (66.7%)	
Institutional Medicaid	98 (17.3%)	74 (24.3%)	103 (25.9%)	2 (11.1%)	
Military / Govt	5 (0.9%)	9 (3%)	7 (1.8%)	1 (5.6%)	
No Fault / Workers Comp	2 (0.4%)	1 (0.3%)	2 (0.5%)	-	

Table 1. Basic demographic and insurance information of the included patients.

	HiRoC (-)	HiRoC (+) DXA (-)	HiRoC (+) DXA (+) MED (-)	HiRoC (+) DXA (+) MED (+)	p-value
Subsequent fracture rates, %	28.32%	15.74%	12.59%	5.56%	<b>&lt;0.01*</b>
Subsequent fracture, n (%)					
Femur	41 (25.6%)	15 (31.3%)	9 (18%)	-	
Upper Extremity	36 (22.5%)	6 (12.5%)	11 (22%)	-	
Vertebrae	34 (21.3%)	16 (33.3%)	3 (6%)	1 (5.6%)	
Multi-Level Fractures	3 (1.9%)	6 (12.5%)	1 (2%)	1 (5.6%)	
Lumbar vertebrae	21 (13.1%)	5 (10.4%)	1 (2%)	-	
Thoracic vertebrae	8 (5%)	5 (10.4%)	1 (2%)	-	
Cervical vertebrae	2 (1.3%)	-	-	-	
Pelvis	16 (10%)	5 (10.4%)	1 (2%)	-	0.054
Multiple Anatomical Sites	12 (7.5%)	1 (2.1%)	9 (18%)	-	
Ribs	11 (6.9%)	1 (2.1%)	1 (2%)	-	
Foot & Ankle	6 (3.8%)	1 (2.1%)	-	-	
Face	2 (1.3%)	1 (2.1%)	-	-	
Isolated tibia or fibula	2 (1.3%)	1 (2.1%)	3 (6%)	-	
Identified subsequent fracture mechanism, n (%)					
Fall	124 (77.5%)	31 (64.6%)	34 (68%)	-	
Compression fracture	24 (15%)	13 (27.1%)	3 (6%)	1 (5.6%)	<b>&lt;0.01</b>
Other low-energy trauma	3 (1.9%)	3 (6.3%)	4 (8%)	-	
Unknown	9 (5.6%)	1 (2.1%)	9 (18%)	-	

Table 2. Detailed information on subsequent fractures in the two-year follow-up period for the different cohorts in the study.

\*p-value (Chi-Square test) is <0.01 for differences in subsequent fracture rates across all cohorts and for HiRoC (+) vs HiRoC (-) groups.