Inequity Impacts Recovery from Open Reduction and Internal Fixation of Humeral Shaft Fractures

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INTRODUCTION: Social determinants of health are assessed by limited access to resources due to poverty, discrimination, socioeconomic status, and other marginalizing factors. The purpose of this study was to investigate the role between racial and economic inequity and orthopaedic trauma, including radiographic fracture healing, complication rates, and patient-reported outcomes following open reduction and internal fixation (ORIF) of humeral shaft fractures. We hypothesize that patients faced with higher levels of social disparity will have an increased likelihood of postoperative complications and worse patient-reported outcomes.

METHODS: We retrospectively reviewed patients who underwent ORIF of humeral shaft fractures at our Level-I trauma center. The Area Deprivation Index, a comprehensive metric of socioeconomic status, education, income, employment, and housing quality, was used to stratify patients into four quartiles. ADI values were normalized between (0-100), with higher scores representing greater social deprivation. Demographic characteristics, OTA fracture classification, time to union, complications, operative details, and PROMIS outcomes were reviewed and analyzed. Time to radiographic union was determined using the Radiographic Union Scores for Humeral fractures (RUSHu) scoring system. An intra-reader reliability score was measured to determine agreement between repeated evaluation of the radiographs and was calculated using the intraclass correlation coefficient (ICC). Statistical analysis was performed on most deprived (top 75thile) and least deprived (bottom 25thile) ADI quartiles. Statistical significance was set at a p-value of < 0.05.

RESULTS: Ninety-eight patients met the inclusion criteria. The mean age for the cohort was 51 for the least deprived quartile and 43 for the most deprived quartile (p=0.04). The average ADI value was 65. The ADI threshold criteria for the least (n=49) and most (n=49) deprived ADI quartiles were 53 and 84, respectively. The most deprived group had significantly more patients who self-identified as black (p<0.01). In the least deprived cohort, mechanical ground level fall was the most common mechanism of injury, whereas the majority of humeral shaft fractures in the most deprived cohort were sustained after an MVC/MCC (p=0.004). The most deprived group had a greater number of patients who sustained their injury from a GSW (n=5) than the least deprived group (n=0). The most deprived cohort had 2.29 greater odds of experiencing a postoperative complication than the least deprived cohort (p=0.04). The average arc of elbow motion in the most deprived group was 107 degrees, while the average arc of motion in the least deprived group was 135 degrees (p=0.04). PROMIS Pain Interference (PI) and Depression (D) scores were higher in the most deprived group (p<0.01 and 0.01, respectively), while PROMIS Physical Function (PF) scores were higher in the least deprived group (p=0.008). The intraclass correlation coefficient (ICC) across all reads was 0.82 (95% CI 0.78-0.85).

DISCUSSION AND CONCLUSION: Patients from the most resource-deprived areas had greater representation of self-identified black individuals, greater odds of a postoperative complications, and lower PROMIS PF scores. Further investigation is warranted to assess the role of racial and economic inequity on access and compliance with physical therapy and factors affecting postoperative rehabilitation. These findings highlight the importance of developing interventions to reduce inequities faced by patients from low-resource settings.

Figure 1. PROMIS Scores at 6-month follow-up, least deprived vs. most deprived patient quartiles.
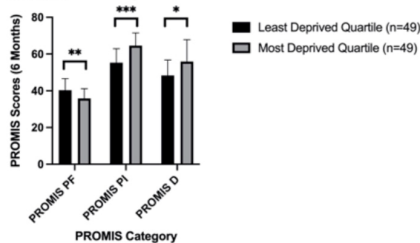
PF Physical Function; PI Pain Interference; D Depression; <0.05 (*); <0.01 (**); <0.0001 (***)

Figure 1. PROMIS Scores at 6-month follow-up, least deprived vs. most deprived quartiles.
Unpaired t-test analysis reveals that compared to the least deprived cohort, the most deprived cohort had lower PROMIS PF scores [35.9 ±5.3 vs. 40.32±6.3; p<0.01], higher PROMIS PI scores [64.6±6.9 vs. 55.3±7.6; p<0.0001], and higher PROMIS D scores [55.9±11.9 vs. 48.35±8.4; p=0.01].

Table 1. Demographic characteristics and outcomes data, least deprived vs. most deprived patient quartiles.

Patient Group		Least Deprived Quartile (n=49)	Most Deprived Quartile (n=49)	OR (95% CI)	p value
National Area Deprivation Index (ADI) Score		36.94 (12.38)	92.41 (5.47)		**0.0001**
Sex	Male	20	28		0.1596
	Female	29	21		
Race	White	45	25		**0.0001**
	Black	2	19		
	Other	2	5		
Age (years)		51.18 (19.84)	43.02 (20.0)		**0.0453**
BMI		30.50 (7.18)	31.77 (9.21)		0.4488
Time to Surgery (days)		31.80 (60.62)	22.48 (56.49)		0.4332
Operative Route	Primary Surgical Intervention	36	40		0.4682
	Attempted Conservative Treatment	13	9		
OTA Fracture Classification	A	27	33		0.4103
	B	12	10		
	C	10	6		
Injury Type	Fall	31	16		**0.0037**
	MVC/MCC	17	28		
	GSW	0	5		
	Pathologic	1	0		
Intra-Operative Blood Loss (mL.)		268.44 (197.01)	400.65 (382.26)		**0.0417**
Total Operative Time (min)		212.37 (64.56)	215.76 (89.02)		0.8506
Time to Radiographic Union (weeks)		17.89 (8.92)	18.98 (9.55)		0.5776
Post-Operative Complications	Overall Complication Rate	20	30	2.29 (1.02-5.14)	**0.0448**
	Non-Union	1	4	4.27 (0.46-39.6)	0.2020
	Radial Nerve Injury	9	8	0.87 (0.31-2.47)	0.7902
	Severe Shoulder Pain/Stiffness	9	14	1.82 (0.71-4.72)	0.2163
PROMIS Score at 6-Month Follow-Up	Physical Function	40.32 (6.3)	35.86 (5.3)		**0.0082**
	Pain Interference	55.30 (7.6)	64.57 (6.9)		**0.0001**
	Depression	48.35 (8.4)	55.90 (11.9)		**0.0142**
Elbow Arc of Motion at Follow-Up		135 (28)	107 (43)		**0.0434**