A Cross-sectional Study of the Association between Homelessness and Facial Fractures

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Background: Little is known about the risk factors for facial fractures among homeless patients. We investigated the association between homelessness, mechanism of injury, and type of facial fracture in patients treated at an urban trauma center.

Methods: Data for 2,221 adults with facial fractures were obtained retrospectively from a standardized registry of trauma patients at Zuckerberg San Francisco General Hospital from 2011 to 2016. Associations between homelessness and mechanism of injury, facial fracture type, and surgical repair type were evaluated with multivariate multinomial logistic regression analysis.

Results: Among 2,221 patients with facial fractures, 12% were homeless and, compared with housed patients, more likely to be male, black, and test positive for drug and alcohol use (all $P < 0.0001$). They had lower injury severity scores but longer hospital stays and were more likely to be discharged to the community than to a rehabilitation facility (all $P < 0.0001$). After adjusting for confounding variables, homeless patients with facial fractures were nearly 3-fold more likely to have been assaulted than housed patients (OR = 2.8, 95% CI = 1.9–4.1, $P < 0.0001$) and twice as likely to have mandible fractures (OR = 2.0, 95% CI = 1.3–3.0, $P = 0.0030$) and to have surgery for these fractures (OR = 2.1, 95% CI = 1.2–3.7, $P = 0.0110$).

Conclusions: Our novel results demonstrate that homeless patients with facial fractures are at much higher risk than the general population for being assaulted, suffering mandible fractures, and requiring surgery for these fractures. Further investigations could guide identification, treatment, and prevention efforts. *(Plast Reconstr Surg Glob Open 2019;7:e2254; doi: 10.1097/GOX.0000000000002254; Published online 27 June 2019.)*

INTRODUCTION

Homeless patients are a vulnerable group who are susceptible to traumatic injuries[1] and have worse health outcomes than the general population.[1–3] Traumatic injuries in homeless patients are associated with alcohol, drug, and mental health problems.[4] The most common presenting traumatic injuries described for this group are lower extremity injuries, contusions, abrasions, and burns.[1]

Little is known about facial fractures in homeless patients. The reported incidence is anywhere from 14% to 20%.[5,6] Beyond this, there have been no robust statistical analyses of the characteristics and risk factors of homeless patients with facial fractures in large urban areas. For the general adult population, the primary mechanisms of facial fractures are motor vehicle accidents, assault, and falls.[7,8] However, assault has increasingly become the primary mechanism of facial fractures in U.S. urban centers such as Detroit, Boston, and Chapel Hill.[9–11] Common types of facial fractures in the general population include nasal bone, mandible, and mala/maxilla fractures. Assault victims with facial fractures also suffer from poverty and drug and alcohol abuse.[5] These findings led us to hypothesize that homeless patients would have a higher risk of facial fracture related to assault than patients who were housed and be more likely to suffer mandible fractures due to assault. If these risks were greater for homeless patients, this knowledge could be used to advance advocacy efforts for better preventative measures and resource allocation for homeless adults while they are in the hospital.

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To test this hypothesis, we conducted a cross-sectional study of trauma patients at an urban trauma center.

METHODS

Study Design and Data Collection

We conducted a cross-sectional study of trauma patients treated at Zuckerberg San Francisco General (ZSFG) Hospital and Trauma Center from 2011 to 2016 who sustained facial fractures.

We included all adult patients who were diagnosed with facial fractures and who were entered into the ZSFG Trauma Registry. This registry includes all patients for whom the surgical trauma team was consulted in the emergency department when the patient arrived. There are specific criteria lists for the specific trauma activations at ZSFG. Patients are activated as a noncritical or critical trauma from the field or in the emergency department as determined by mechanism of injury, age, types and numbers of injuries, Glasgow coma score, hemodynamic status, respiratory status, and paralysis attributable to trauma and/or at the discretion of the emergency department team.

Trained nurses with experience in emergency medicine and critical care review the patients' charts, identify injuries, and determine injury severity score. Once the data are abstracted, trauma registrars enter the data and perform the appropriate coding. We included all adult patients (age ≥ 18 years) who were diagnosed with any type of facial fracture based on International Classification of Disease (ICD)-9 code 802 regardless of their subsequent disposition. Patients were categorized as homeless or housed, which was reported by the patient at the initial encounter. Homeless patients are those who do not have a home address and include patients who live on the street and potentially in housing shelters.

Outcomes

The outcome variables, such as *mechanism of injury, facial fracture type,* and *surgical repair type,* were grouped into categories based on ICD-9 and E-codes. We categorized mechanism of injury into the following 5 main groups: motor vehicle accidents (E-code 810–819, E820–E825), assault (E960–E969), falls (E880–E888), bike accidents (E826.3–E826.9), and all other (E-codes not previously listed) or multiple mechanisms. We categorized facial fracture type into the following 6 main groups: nasal bone (ICD-9 802.0–802.1), mandible (802.2–802.3), mala/maxilla (802.4–802.5), orbital floor (802.6–802.7), other (802.8–802.9), and multiple (any combination of the previously listed codes). We categorized surgical repair type into the following 5 main groups: nasal (ICD-9 21.71–21.99), mala/maxilla (ICD-9 24.5, 76.65–76.77), mandible (ICD-9 76.75–76.76), other (ICD-9 22.42, 76.69, 76.78, and 76.79), and no surgery. Demographic and other outcome data (injury severity score, alcohol and drug use, Intensive Care Unit (ICU) length of stay, hospital length of stay, ventilator support days, death, and discharge disposition) were obtained directly from the registry.

Statistical Analysis

We assessed whether the risk of specific mechanisms of injury, facial fracture type, and surgical repair type varied between homeless and housed patients with facial fractures. To determine these associations, we performed univariate and multivariate multinomial logistic regressions. For each outcome, we chose one category to serve as the reference against which the other outcomes were measured. For the mechanism of injury, the reference category was falls. For facial fracture type, the reference category was multiple fractures. For surgical repair type, the reference category was no surgery. These were chosen because they were the most prevalent category.

To perform the multivariate analysis, because the number of orbital floor fractures was too low as a stand-alone category to detect a difference in the analysis, we had to group them into the *other* category for the facial fracture type outcome.

To determine the confounding variables, we ran univariate models measuring the associations between the confounders and the 3 primary outcomes. We only included confounding variables that were significantly associated with the outcome. We also created a new race and ethnicity variable that included white, Hispanic, and other because there were too few numbers in the other categories.

We calculated 95% confidence intervals for each of the odds ratios and tested the statistical significance using Wald tests setting alpha <0.05.

RESULTS

There were 2,221 adult patients with facial fractures identified in our registry for the 5-year study period. In this cohort, 87% were housed and 12% were homeless. As summarized in Table 1, for all patients, falls were the most common mechanism of injury (31%) followed by motor vehicle accidents (27%). Among homeless patients, assault was the most common mechanism of injury

TABLE 1. Number and Percentages of Mechanism of Injury, Fracture Type, and Surgical Repair Type for Homeless Versus Housed Patients with Facial Fractures

	Homeless, n = 275	Housed, n = 1,946	Total, N = 2,221
Mechanism of Injury			
Falls	55 (20%)	641 (33%)	696 (31%)
Motor vehicle accidents	47 (17%)	541 (28%)	588 (27%)
Assault	129 (47%)	423 (22%)	552 (25%)
Bike accidents	11 (4%)	154 (8%)	165 (7%)
Other/multiple	33 (12%)	187 (10%)	220 (10%)
Fracture type			
Nasal	80 (29%)	510 (26%)	560 (27%)
Mandible	38 (14%)	155 (8%)	193 (9%)
Mala/maxilla	24 (9%)	210 (11%)	234 (11%)
Orbital floor	4 (2%)	56 (3%)	60 (3%)
Other	20 (7%)	159 (8%)	179 (8%)
Multiple	109 (40%)	856 (44%)	965 (43%)
Surgical repair type			
None	240 (87%)	1,794 (92%)	2,034 (92%)
Nasal	3 (1%)	10 (1%)	13 (1%)
Mala/maxilla	2 (1%)	23 (1%)	25 (1%)
Mandible	21 (8%)	67 (3%)	88 (4%)
Other/multiple	9 (3%)	52 (3%)	61 (3%)

(47%) and nasal bone fractures were the most common isolated fracture type, followed by mala/maxilla bone fractures (27%). Multiple facial fractures (43%) were the most common type of fracture overall. Most patients did not undergo surgery for their facial fractures. However, of the surgeries performed for facial fractures, surgery on the mandible was the most common for both groups, although the rate was higher among homeless patients (8% versus 3%). The most common surgery of the mandible was open reduction, internal fixation.

Our univariate comparison of the 2 groups (summarized in Table 2) showed that on average, the homeless group was slightly younger than the housed group (45 ± 12 versus 48 ± 21 years, $P = 0.27$) and included more males (91% versus 75%, $P < 0.0001$). The housed and homeless groups contained equal numbers of White patients, whereas twice as many black patients were homeless, and significantly more Asian patients were housed ($P < 0.0001$). Homeless patients were more likely to test positively for illegal drug use and to have higher rates of alcohol use ($P = 0.001$ and $P < 0.0001$). Housed patients had a higher mean injury severity score than homeless patients ($P < 0.0001$). On average, the homeless group stayed in the hospital 3 days longer than the housed group ($P < 0.0001$), but housed patients were more likely to die in the hospital ($P = 0.001$). More homeless patients than housed patients were discharged to the community, and more housed patients were discharged to another care facility ($P < 0.0001$).

The confounding variables identified on univariate analysis for the mechanism of injury were race and ethnicity, sex, age, current drug use, current alcohol use, history of major psychiatric illness, and history of impaired sensorium. The confounding variables for facial fracture type and surgical repair type were sex, age, current drug use, and current alcohol use. According to our multivariate analysis and after we adjusted for the confounding variables, the odds to have been assaulted rather than to have fallen were 2.8 times higher in homeless patients than housed patients with facial fractures (OR = 2.8, 95% CI = 1.9–4.1, $P < 0.0001$) (Table 3). The odds of having a mandible fracture compared with nasal bone fracture were 2 times higher in homeless patients than in housed patients (OR = 2.0, 95% CI = 1.3–3.0, $P = 0.003$) (Table 3). Finally, the odds for homeless patients to have surgery on their mandible fracture compared with no surgery at all were 2 times higher than the housed patients with facial fractures (OR = 2.1, 95% CI = 1.2–3.7, $P = 0.01$) (Table 3). When looking at the treatment of operative mandible fractures for all patients, 16 patients had closed reduction compared to 102 patients who had an open reduction in their mandible fracture.

DISCUSSION

In this study, we investigated the association between homelessness and mechanism of injury, facial fracture

TABLE 2. Demographic Characteristics and Outcomes of Homeless and Housed Patients with Facial Fractures

	Homeless, n = 275	Housed, n = 1,946	P
Age in years at time of facial fracture, mean ± SD	45 ± 12	48 ± 21	0.27
Sex			<0.0001
Female	25 (9%)	482 (25%)	
Male	250 (91%)	1,464 (75%)	
Blood alcohol level, mean	133 ± 153 (n = 167)	106 ± 132 (n = 944)	0.04
Injury severity score, mean	12 ± 10	14 ± 12	<0.0001
ICU length of stay, mean (days)	3 ± 6	2 ± 6	0.52
Ventilator support duration, mean (days)	6 ± 7	6 ± 8	0.86
Hospital length of stay, mean (days)	9 ± 17	6 ± 13	<0.0001
Final outcome			0.001
Alive	268 (98%)	1,788 (92%)	
Died	7 (2%)	158 (8%)	
Race			<0.0001
White	185 (67%)	1,323 (68%)	
Black	61 (22%)	217 (11%)	
Asian	7 (3%)	315 (16%)	
Other/unknown	22 (8%)	91 (5%)	
Ethnicity			0.31
Hispanic/Latino	67 (24%)	426 (22%)	
Not Hispanic/Latino	195 (71%)	1,454 (75%)	
Unknown	13 (5%)	66 (3%)	
Alcohol use			0.001
Unknown	69 (25%)	584 (30%)	
No	119 (43%)	926 (48%)	
Yes	87 (32%)	436 (22%)	
Drug use			<0.0001
Unknown	73 (27%)	585 (30%)	
No	122 (44%)	1,208 (62%)	
Yes	80 (29%)	153 (8%)	
Discharge disposition			<0.0001
Discharged to home	150 (55%)	867 (45%)	
Discharged to care facility	21 (8%)	208 (11%)	
Transferred to another hospital	4 (2%)	184 (10%)	
Against medical advice	26 (10%)	31 (2%)	
Not admitted	59 (22%)	477 (25%)	
Other	8 (3%)	21 (1%)	

Other, discharged to psychiatric facility, jail, or transferred to another facility.

TABLE 3. Univariate and Multivariate Logistic Regression Results for Mechanism of Injury, Fracture Type, and Surgical Repair Type

	Univariate		Multivariate	
	Odds Ratio [CI]	P	Odds Ratio [CI]	P
Mechanism of injury*				
Motor vehicle accidents	1.0 [0.68–1.5]	0.95	0.93 [0.60–1.4]	0.73
Assault	3.6 [2.5–5.0]	<0.0001	2.8 [1.9–4.1]	<0.0001
Bike accidents	0.83 [0.43–1.6]	0.59	0.72 [0.36–1.5]	0.36
Other/multiple	2.1 [1.3–3.3]	0.002	1.3 [0.78–2.1]	0.32
Fracture type†				
Mandible	1.9 [1.3–2.9]	0.002	2.0 [1.3–3.0]	0.003
Mala/maxilla	0.90 [0.56–1.4]	0.65	1.0 [0.64–1.7]	0.89
Nasal	1.2 [0.91–1.7]	0.19	1.4 [0.98–1.9]	0.07
Other	0.88 [0.55–1.4]	0.58	1.1 [0.64–1.7]	0.85
Surgery for facial fracture	1.7 [1.2–2.6]	0.007	1.5 [0.96–2.3]	0.080
Surgical repair type‡				
Nasal	2.2 [0.61–8.2]	0.22	2.3 [0.54–9.6]	0.27
Mala/maxilla	0.65 [0.15–2.8]	0.56	0.54 [0.11–2.4]	0.42
Mandible	2.3 [1.4–3.9]	0.001	2.1 [1.2–3.7]	0.01
Other	2.3 [0.74–7.1]	0.15	2.1 [0.63–7.2]	0.23
Multiple	0.96 [0.37–2.5]	0.93	0.79 [0.29–2.1]	0.64

*Reference category = falls.
†Reference category = multiple facial fractures.
‡Reference category = no surgery.

type, and surgical repair type in adult patients with facial fractures. The results of our multivariate, multinomial regression analysis show that homeless patients with facial fractures were almost 3 times more likely than housed patients to have had assault as the cause of their fracture, when confounding variables were controlled for. Our analysis also shows that homeless patients are 2 times more likely than housed patients to have an isolated mandible fracture and to undergo open reduction, internal fixation for their mandible fracture.

Our epidemiologic results are comparable to those reported in other studies of urban areas and urban academic centers.[9–11] The main mechanisms of injury for facial fractures in the United States are motor vehicle accidents, assault/interpersonal violence, or falls.[9–11] In our study, falls were the most common mechanism of injury for all patients with facial fractures, but assault was the most common for homeless patients, a finding that held when confounding variables were adjusted for by multivariate logistic regression analysis. Similarly, the main types of facial fracture reportedly vary among isolated nasal bone, mala/maxilla, and mandible fractures.[9–11] One study found that mandible fractures were primarily caused by interpersonal violence in drug and alcohol users.[12] Our results are not only consistent with these previous general epidemiologic studies on facial trauma but also novel in demonstrating that homeless patients are at much higher risk for being assaulted and suffering mandible fractures.

Previous studies report that male patients suffer from facial trauma more than female patients.[11,13,14] Our study shows that this greater rate of male facial trauma is also statistically significant in the homeless population in San Francisco. Regarding the race and ethnicity of patients with facial fractures in the United States, little has been reported. A study in Detroit, MI, showed a fairly even distribution of facial fractures among white, black, and Asian patients of both sexes, although women ≥60 years of age were more likely to be white.[14] Our study clearly shows that black and homeless patients in San Francisco are at higher risk for facial fracture and that being Asian and housed are protective for facial fractures. This is likely because more homeless patients identify as black (34% versus 6% of general population) than Asian (4% versus 34% of general population) in San Francisco.[15]

It is unsurprising that homeless patients with facial fractures in our study were more likely to test positively for illegal drug use and alcohol use because homeless patients are at higher risk for mental illness and substance abuse disorders and are more likely to be using drugs or alcohol at the time of injury.[1,16] Substance abuse and mental illness have also been shown to be independent risk factors for both intentional and unintentional injuries.[16] However, the type of injury has not been previously explored. We have shown that homeless patients with facial fractures have higher rates of illegal drug and alcohol use compared with the general population.

Some of our results were unexpected. Homeless patients with facial fractures had slightly lower injury severity scores with longer hospital stays and were less likely to die than their housed counterparts. One explanation for

these findings is that housed patients' higher likelihood of motor vehicle accidents as their mechanism of injury (28% versus 17%) could have resulted in a higher rate of multiple traumatic injuries, higher injury severity scores, and a higher likelihood of death. We considered validated injury scores that are specific to facial trauma; however, we were limited by the variables that were provided in the Trauma Registry, which does not include the Facial Injury Severity Scale or Mandible Injury Severity Score.[17–19] It is possible that homeless patients may be spending more time recuperating in the hospital before being discharged back to the community. In contrast, housed patients were more likely to be discharged to a care facility.

It has been previously shown that homeless patients incur more healthcare expenditures compared with housed patients with over double the cost per patient per month.[20] Additionally, homeless patients without health insurance use more acute hospital services than ambulatory services, which is more expensive.[21] In our study, it is apparent that homeless patients with facial fractures stay in the hospital longer than house patients, which is more costly to the healthcare system. However, it is unclear why they do. One study showed that only 33% of homeless patients with orthopedic surgery needs completed follow-up. One explanation for why homeless patients with operative facial fractures at ZSFG have longer hospital stays compared with their housed counterparts is that the surgeons are admitting them for what could be done as an outpatient surgery, because there is a low rate of follow-up. These Trauma Registry data do not include follow-up information beyond the one encounter reported, so that data are not available for our study. This disparity that we have identified needs to be explored further, because not only do longer hospital stays have significant cost implications on the healthcare system, but also it may mean that discharge resources for homeless patients are lacking in San Francisco.

Our study has several limitations. First, it is a single-institution, retrospective study examining single patient encounters and lacks follow-up data and outcomes after discharge from the hospital. Because of this restriction, we can only make conclusions based on the admission and discharge of this one encounter. We had reported that 92% of all patients with facial fractures did not undergo surgery during their initial encounter. However, this does not mean that they did not have a surgery at a later time or on a different encounter or admission. The data are better interpreted to mean that when comparing both housed and homeless patients with facial fractures, more homeless patients had surgeries during their initial trauma encounter. As previously mentioned, this could mean that homeless patients were being admitted for their operative facial fractures, whereas housed patients were not, because they could more reliably follow-up for outpatient surgery.

In addition to above limitations, our analysis relies on E-codes and ICD-9 procedure and surgical codes, which are broad and have inherent limitations. For instance, the ICD-9 code for mala/maxilla fractures does not differentiate between LeFort fractures versus maxillary sinus fractures,

which have different clinical implications and significance. However, our limitations also guide our future directions. Because current ICD-10 coding is more specific regarding facial fracture type, which may be more clinically relevant, more recent injury data can be analyzed accordingly. Additionally, it would be important to investigate whether other urban areas and trauma centers around the United States have similar results regarding facial fractures in homeless patients as this is only a single-institution study. This is important to generalize these risk factors and treatment of homeless patients with facial fractures across the United States. Another focus for future studies would be on why homeless patients with mandible fractures require surgical repair more often than housed patients and the long-term clinical outcomes of facial fractures in both homeless and housed patients. The ultimate goal of such studies would be to develop and refine prevention efforts for homeless patients with facial fractures—a vulnerable group. It is paramount that there is continued communication and multidisciplinary support such as social workers and caseworkers to enable and ensure that homeless patients with facial fractures follow-up regularly and comply with care including diet and antibiotic therapy. This highlights the need for dedicated clinics or increased resources to prevent cycles of injury among homeless individuals.

CONCLUSIONS

Our cross-sectional study of 2,221 adult patients with facial fractures showed that homeless patients with facial fractures are more likely to have been assaulted, suffer mandible fractures, and require surgery for their facial fractures than their housed counterparts. Further investigations of these unique characteristics in this at-risk population can help guide identification, treatment, and prevention efforts to reduce the incidence of facial fractures and improve outcomes for homeless patients.

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