J Shoulder Elbow Surg (2021) 30, 229–236

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

Are there racial differences between patients undergoing surgery for shoulder instability? Data from the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability Group

Carolyn M. Hettrich, MD, MPH[a], Anthony Zacharias, MD[b,*], Shannon F. Ortiz, MPH[c], Philip Westgate, PhD[b], MOON Shoulder Group, Brian R. Wolf, MD, MS[c], Cale Jacobs, PhD[b]

[a]*Department of Orthopaedic Surgery, Brigham and Women's Hospital, Boston, MA, USA*
[b]*Department of Orthopaedic Surgery, University of Kentucky, Lexington, KY, USA*
[c]*Department of Orthopaedic Surgery, University of Iowa, Iowa City, IA, USA*

Background: The purpose of this study was to identify differences related to race in preoperative and intraoperative findings of patients undergoing operative treatment for shoulder instability.
Methods: Data from the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability cohort were used. Of 1010 patients, 995 provided race and ethnicity information and were included in the analyses. Demographic characteristics, injury history, radiographic and intraoperative findings, and preoperative patient-reported instability, pain, and function were compared (1) between white and minority patients and (2) in a subgroup analysis between white patients and the 3 largest minority groups. The Distressed Communities Index (DCI) score was recorded for each patient's home ZIP code. Multiple logistic regressions were performed to determine whether models consisting of race/ethnicity, insurance carrier, and/or DCI score were predictive of bone and cartilage loss at the time of surgery.
Results: Compared with white patients, a greater percentage of US minority patients had ≥2 dislocations (68.0% vs. 57.1%, $P = .01$), which corresponded with more frequent articular cartilage lesions (62.2% vs. 51.0%, $P = .007$) and increased frequencies of glenoid bone loss > 10% (16.2% vs. 8.7%, $P = .03$) and Hill-Sachs lesions (68.6% vs. 56.0%, $P = .004$). Specifically, when compared with white patients, African American and Asian patients showed significantly increased frequencies of glenoid bone loss > 10% (19.7% of African American patients, 18.4% of Asian patients, and 8.9% of white patients; $P = .01$) and Hill-Sachs lesions (65.6%, 71.7%, and 52.4%, respectively; $P = .02$). Race was an independent predictor of articular cartilage lesions ($P = .04$) and the presence of Hill-Sachs lesions ($P = .01$). A higher DCI score ($P = .03$) and race ($P = .04$) were both predictive of having glenoid bone loss > 10%.

The MOON Shoulder Group consists of Keith M. Baumgarten, MD, Julie Y. Bishop, MD, Matthew J. Bollier, MD, Jonathan T. Bravman, MD, Robert H. Brophy, MD, Charles L. Cox, MD, MPH, Brian T. Feeley, MD, John A. Grant, MD, PhD, Grant L. Jones, MD, John E. Kuhn, MD, MS, C. Benjamin Ma, MD, Robert G. Marx, MD, MSc, Eric C. McCarty, MD, Bruce S. Miller, MD, MS, Andrew S. Neviaser, MD, Adam J. Seidl, MD, Matthew V. Smith, MD, Rick W. Wright, MD, and Alan L. Zhang, MD.

This study was presented at the American Orthopaedic Society for Sports Medicine/Arthroscopy Association of North America Specialty Day; Las Vegas, NV, USA; March 16, 2019.

This study was approved by the Institutional Review Board at the University of Iowa (DHHS registration no. IRB00000099) and the University of Kentucky Office of Research Integrity Institutional Review Board (RDRC, no. 44750). Institutional review board approval was obtained from each institution participating in the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability study, and all patients provided informed consent prior to participating.

*Reprint requests: Anthony Zacharias, MD, Department of Orthopaedic Surgery, University of Kentucky, 740 S Limestone, K401, Lexington, KY 40503, USA.

E-mail address: Anthony.Zacharias@uky.edu (A. Zacharias).

https://doi.org/10.1016/j.jse.2020.09.043

Conclusion: We found that minority race was associated with increased number of preoperative dislocations and increased frequency of articular cartilage and Hill-Sachs lesions at the time of surgery, and both minority race and an increased DCI score were associated with glenoid bone loss $> 10\%$. Further research is needed to understand the underlying reason for these differences and to optimize care for all patients with shoulder instability.

Level of evidence: Level II; Prospective Cohort Design; Prognosis Study

Keywords: Shoulder; instability; Bankart; health care disparities; glenoid bone loss; racial disparities; Hill-Sachs

Identification of disparities and health care differences is an initial step in creating strategies for change and measurement of progress. Several studies comparing white patients and minority patients have shown both decreased utilization and worse outcomes of total knee arthroplasty (TKA) and total shoulder arthroplasty in the latter group,[12,18,19,21,33,34,38,39] but it remains unclear if racial differences exist in a younger population undergoing surgical correction of shoulder instability.

Racial disparities in the utilization of surgical correction of shoulder instability may potentially lead to inferior long-term outcomes and joint health. Intra-articular pathology is a common finding in anterior shoulder instability, with recurrent events being associated with increased pathology.[6,10,20,26,32,35,37] Marshall et al[23] noted decreased rates of postoperative instability and secondary surgery after arthroscopic treatment of first-time dislocators compared with recurrent dislocators. With an increased number of dislocations, there is a greater need for bone augmentation procedures, with these procedures having higher rates of complications.[6]

By use of data from a prospectively collected, multicenter cohort, the purpose of this investigation was to assess the association of race with patient demographic characteristics, preoperative presentation, preoperative patient-reported outcomes (PROs), and clinical, radiographic, and intraoperative findings in patients undergoing shoulder stabilization surgery. We hypothesized that minority groups would have worse preoperative PROs and more bone loss at the time of surgery than white patients.

Methods

Study design

This study was a cross-sectional analysis of preoperative and intraoperative data collected as part of a multicenter study involving 10 institutions throughout the United States. The methods of the Multicenter Orthopaedic Outcomes Network (MOON) have been previously described.[3,7] The MOON Shoulder Instability study is a prospective, multicenter cohort study designed to evaluate predictors of outcomes in patients undergoing surgical management of shoulder instability; nonoperative patients are not included in the study. Patients were prospectively enrolled, and demographic characteristics, injury history, preoperative PRO scores, and radiologic data were preoperatively collected. Intraoperative findings were recorded by each treating orthopedic surgeon. Teleform (Opentext, Waterloo, ON, Canada) (October 2012 to February 2015) and Research Electronic Data Capture (REDCap; Vanderbilt University, Nashville, TN, USA) were used to manage collected data securely.

Participants

Informed consent was obtained from all participants prior to enrollment. Patients enrolled in the MOON Shoulder Instability study were aged between 12 and 66 years; had a diagnosis of anterior, posterior, or inferior instability; and underwent arthroscopic or open surgical repair. Patients were excluded if they were involved in workers' compensation cases, did not speak the English language, were imprisoned, were unable or unwilling to return for clinical follow-up, or had a concomitant rotator cuff tear or fracture other than Hill-Sachs and Bankart lesions.

Of the 1010 patients, 995 (98.5%) provided race and ethnicity information. Consistently with the recommendations of the Agency for Healthcare Research and Quality, patients were asked to specify race with the following options: American Indian/Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Black or African American, White, or prefer not to answer. Patients were asked to identify ethnicity with the options being Hispanic or Latino, not Hispanic or Latino, or prefer not to answer. The cohort largely comprised white patients ($n = 823$), with 172 US minority patients, including 66 African American patients, 49 Asian patients, 35 Hispanic patients, 11 Native American patients, 8 patients of multiple races or ethnicities, and 3 Hawaiian or Pacific Islander patients. For the purposes of this study, all patients were included in the primary analysis of white and US minority patients, and a subgroup analysis was performed for the 4 most populous groups (African American, Asian, white, and Hispanic). The remaining patient groups were excluded because of small sample sizes.

Data for analysis

Baseline data including demographic characteristics, previous treatments, PROs, and medical comorbidities were collected with standardized questionnaires and forms. PROs included the Iowa Personality Disorder Screen, Personality Assessment Screener, Veterans RAND 12-Item Health Survey (VR-12) Physical Component Score, VR-12 Mental Component Score, visual analog scale for pain, American Shoulder and Elbow Surgeons Standardized Shoulder Assessment, Western Ontario Shoulder Instability Index, Marx shoulder activity level,[2] and Single Assessment Numeric Evaluation. Plain radiographs and advanced imaging, if available, were reviewed at the time of enrollment. At the time of surgery, a standardized form that included the patient's preoperative diagnosis was used to collect intraoperative findings including labral tears, biceps injuries, rotator cuff injuries, and cartilage injuries or bone loss of the humeral head or glenoid. The estimates of glenoid and humeral head bone loss were made by the treating surgeon intraoperatively. Bone loss was then categorized into groups of 0%-10%, 11%-20%, 21%-30%, and >30%. Cartilage lesions were classified according to the Outerbridge classification.[28] The interobserver and intraobserver agreement for intraoperative assessment of intra-articular lesions for our group has been previously described.[36] Treatment decisions were left to the discretion of each surgeon and recorded on the operative forms.

To assess potential differences in socioeconomic status, the 2017 Distressed Communities Index (DCI) score was determined for each patient based on his or her home ZIP code. The DCI score was created by the Economic Innovation Group and is based on the following 7 criteria: percentage of adults aged ≥ 25 years without a high school education, percentage of individuals living under the poverty line, percentage of adults aged 25-64 years who are unemployed, median household income as a percentage of the state's median household income, change in number of jobs, change in number of businesses, and percentage of habitable housing that is unoccupied in a given area.[8] Each community is ranked based on the average national ranking of each of the 7 metrics, with all 7 factors weighted equally. The ranking is then normalized to create a percentile so that DCI scores range from 0 to 100, with higher scores indicative of greater economic distress; regions with DCI scores ≥ 80 are considered highly distressed regions. The DCI is a measure of neighborhood social vulnerability and is commonly used in assessments of health care disparities.[4,22] This score has been demonstrated to be an independent risk factor for complications and death after cardiac and bariatric surgery and has been shown to improve surgical risk adjustment.[5,13,24,25]

For the primary overarching comparison of white and US minority patients, continuous variables were compared between groups using 2-tailed independent *t* tests whereas categorical variables were compared using χ^2 or Fisher exact tests as appropriate. For the subgroup analysis between the 4 most populous groups, continuous variables were compared between groups using 1-way analysis of variance with Bonferroni post hoc analysis whereas categorical variables were compared using χ^2 or Fisher exact tests as appropriate. In addition, multiple logistic regressions controlling for age, sex, and whether the dominant shoulder was injured were performed to determine if models consisting of race/ethnicity including the 4 most populous groups, insurance carrier, and/or DCI score were predictive of 4 factors related to injury severity (number of previous dislocations and presence of articular cartilage lesions, glenoid bone loss > 10%, and Hill-Sachs lesions). An α level of $P < .05$ was considered statistically significant, and all analyses were performed using SPSS Statistics (version 24; IBM, Armonk, NY, USA).

Results

Although there were no differences in sex or smoking status between races, there were differences in age and body mass index between groups, with African American patients being the youngest and Hispanic patients having the greatest body mass index values (Table I). Overall, a greater percentage of nonwhite patients had ≥2 dislocations (68.0% [95% confidence interval (CI), 60.5%-74.9%] vs. 57.1% [95% CI, 53.7%-60.5%]; $P = .01$) (Table I), which corresponded with more frequent articular cartilage lesions (62.2% [95% CI, 54.5%-69.5%] vs. 50.9% [95% CI, 47.5%-54.3%]; $P = .007$) and increased frequencies of glenoid bone loss > 10% (16.2% [95% CI, 11.1%-21.8%] vs. 8.7% [95% CI, 8.0%-12.1%]; $P = .03$) and Hill-Sachs lesions (68.6% [95% CI, 61.1%-75.5%] vs. 56.0% [95% CI, 52.5%-59.4%]; $P = .004$) at surgical enrollment (Table II). Open bony procedures were performed in 95 patients (Latarjet in 83, distal tibial allograft in 4, iliac crest in 2, Bristow in 1, allograft [other] in 1, glenoid allograft in 1, and other in 3), and the prevalence of bone augmentation procedures did not differ between groups (13.3% of minority patients vs. 9.2% of white patients, $P = .29$).

In the subgroup analysis, compared with white patients and Asian patients, significantly fewer African American patients had commercial insurance (80.3% [95% CI, 68.7%-89.1%] of African American patients, 95.9% [95% CI, 86.0%-99.5%] of Asian patients, and 93.5% [95% CI, 91.7%-95.1%] of white patients; $P = .001$). African American patients had significantly worse DCI scores than the other 3 groups (African American, 47.6 ± 32.7 [95% CI, 39.4-55.7]; Asian, 28.2 ± 26.3 [95% CI, 20.4-36.0]; white, 28.0 ± 23.9 [95% CI, 26.3-29.6]; and Hispanic, 32.1 ± 29.0 [95% CI, 21.5-42.8]; $P < .001$) (Table I), and a significantly greater proportion of African American patients lived in economically distressed areas (20.3% [95% CI, 11.3%-32.2%] of African American patients vs. 4.3% [95% CI, 0.6%-15.5%] of Asian patients, 2.9% [95% CI, 1.9%-4.5%] of white patients, and 3.2% [95% CI, 0.1%-16.7%] of Hispanic patients; $P < .001$) (Table I).

When compared with white patients, African American and Asian patients showed significantly increased frequencies of glenoid bone loss > 10% (19.7% [95% CI, 13.8%-38.3%] of African American patients, 18.4% [95% CI, 8.8%-32.0%] of Asian patients, and 8.9% [95% CI, 7.0%-11.0%] of white patients; $P = .01$) and Hill-Sachs lesions (65.6% [95% CI, 52.3%-77.3%], 71.7% [95% CI, 56.5%-84.0%], and 52.4% [95% CI, 48.7%-56.0%], respectively; $P = .02$). In addition, articular cartilage lesions were significantly more common among African American patients than white patients (68.1% [95% CI, 11.3%-32.2%] vs. 49.1% [95% CI, 11.3%-32.2%]; $P = .0007$). In the subgroup analysis, we found no differences in the number of patients with ≥2 dislocations prior to surgery (57.3% [95% CI, 53.8%-60.7%] of white patients, 67.7% [95% CI, 54.9%-78.8%] of African American patients, 67.3% [95% CI, 52.5%-80.1%] of Asian patients, and 65.7% [95% CI, 47.8%-80.9%] of Hispanic patients; $P = .17$). Anatomic pathology results of each subgroup are presented in Table II. Despite having more severe intraoperative findings than white patients, African American

Table I Comparison of demographic factors between shoulder instability patients of different races

	White	All minority patients[*]	African American	Asian	Hispanic	*P* value[†]
n	823	172	66	49	35	—
Age, yr	24.3 ± 9.0[‡]	23.3 ± 7.5	21.1 ± 6.2	26.0 ± 8.3[‡]	24.6 ± 8.4	<.001
Male/female sex, n (% female)	662/161 (19.6)	147/25 (14.5)	55/11 (16.7)	39/10 (20.4)	3/35 (8.6)	.41
Body mass index	25.6 ± 4.4	26.0 ± 4.6	26.3 ± 4.9	24.7 ± 3.2	27.3 ± 5.1[§]	.03
Smoker, n (%)	46 (5.4)	11 (6.4)	6 (9.1)	3 (6.1)	1 (2.9)	.24
Distressed Communities Index	28.0 ± 23.9	37.9 ± 31.1[‖]	47.6 ± 32.7[§,‖,¶]	28.2 ± 26.3	32.1 ± 29.0	<.001
Living in distressed location, n (%)[#]	23 of 786 (2.9)	16 of 141 (11.3)[‖]	13 of 64 (20.3)[§,‖,¶]	2 of 46 (4.3)	1 of 31 (3.2)	<.001
≥2 Dislocations, n (%)	470 of 820 (57.3)	117 of 171 (68.4)[‖]	44 of 65 (67.7)	33 of 49 (67.3)	23 of 35 (65.7)	.17
Insurance carrier, n (%)						.001
Commercial	770 (93.5)[‡,**]	148 (86)	53 (80.3)	47 (95.9)[‡]	30 (85.7)	
Medicaid	26 (3.2)	16 (9.3)[‖]	9 (13.6)[§,‖]	1 (2.0)	3 (8.6)	
Medicare	0 (0)	1 (0.6)	0 (0)	1 (2.0)	0 (0)	
Workers' compensation	1 (0.1)	1 (0.6)	0 (0)	0 (0)	1 (2.9)	
Other or unknown	26 (3.2)	6 (3.5)	4 (6.0)	0 (0)	1 (2.9)	
Level of education, n (%)						<.001
High school or less	326 (39.6)	63 (36.6)	36 (55.5)[§,‖]	7 (14.3)	13 (37.1)	
Some college or more	497 (60.4)[‡]	109 (63.4)	30 (45.5)	42 (85.7)[‡,‖]	22 (62.9)	
Employment, n (%)						.003
Full time	316 (38.6)[‡]	57 (33.3)	13 (19.7)	24 (49.0)[‡]	15 (42.9)[‡]	
Part time, retired, or homemaker	169 (20.7)	27 (15.8)	10 (15.2)	7 (14.3)	4 (11.4)	
Student	129 (15.8)	33 (19.3)	12 (18.2)	9 (18.4)	8 (22.9)	
Unemployed or disabled	204 (24.9)	54 (31.6)	31 (47.0)	9 (18.4)	8 (22.9)	

[*] All minority patients including groups that were not included in subgroup analysis.
[†] *P* values from 1-way analysis of variance comparing white, African American, Asian, and Hispanic patients.
[‡] Significantly greater than in African American patients.
[§] Significantly greater than in Asian patients.
[‖] Significantly greater than in white patients.
[¶] Significantly greater than in Hispanic patients.
[#] Defined as Distressed Communities Index ≥ 80. Complete Distressed Communities Index and race information was available for 927 patients.
[**] Significantly greater than in minority patients.

patients had significantly greater preoperative Single Assessment Numeric Evaluation scores and Asian patients had significantly lower visual analog scale pain scores (Table III). Hispanic patients also showed significantly greater VR-12 Physical Component Scores than white patients (Table III).

After controlling for age, sex, and whether the dominant arm was injured, we found race to be an independent predictor of the presence of either articular cartilage lesions ($P = .04$, Table IV) or Hill-Sachs lesions ($P = .01$, Table V). A higher DCI score ($P = .03$) and race ($P = .04$) were predictive of bone loss > 10% (Table VI).

Table II Comparison of differences in anatomic pathology between racial/ethnic groups

	White, n (%)	African American, n (%)	Asian, n (%)	Hispanic, n (%)	*P* value
Glenoid bone loss > 10%	73 of 823 (8.9)	13 of 66 (19.7)*	9 of 49 (18.4)*	3 of 35 (8.6)	.01
Articular cartilage lesion	419 of 823 (50.9)	45 of 66 (68.2)*	28 of 49 (57.1)*	19 of 35 (54.3)	.05
Hill-Sachs lesion	398 of 760 (52.4)	40 of 61 (65.6)*	33 of 46 (71.7)*	20 of 34 (58.8)	.02

* Significantly greater than in white patients.

Table III Comparison of preoperative patient-reported instability, pain, function, and psychosocial factors between US minority and white shoulder instability patients

	White	African American	Asian	Hispanic	*P* value*
ASES score	65.2 ± 19.9	66.8 ± 23.3	72.6 ± 18.8	66.5 ± 23.0	.09
WOSI score	1205 ± 398	1152 ± 502	1125 ± 412	1240 ± 419	.40
SANE score	45.0 ± 23.5	57.2 ± 24.0†	47.5 ± 22.1	49.0 ± 24.2	.001
Marx shoulder activity level	13.3 ± 4.3‡	11.6 ± 4.9	12.2 ± 4.9	13.7 ± 4.3	.007
VAS pain score	2.9 ± 2.4§	3.1 ± 2.8§	1.7 ± 1.9	3.3 ± 2.8§	.003
VR-12 PCS	46.1 ± 8.0	46.9 ± 8.5	46.9 ± 7.5	50.0 ± 6.4†	.04
VR-12 MCS	51.1 ± 10.3	51.8 ± 9.9	48.7 ± 9.7	49.3 ± 13.6	.26
IPDS score‖	1.1 ± 1.9	1.4 ± 1.7	1.5 ± 2.4	1.9 ± 2.7	.04
PAS score	27.5 ± 25.9	29.8 ± 28.7	28.3 ± 25.7	33.4 ± 30.6	.56

ASES, American Shoulder and Elbow Surgeons; *WOSI*, Western Ontario Shoulder Instability Index; *SANE*, Single Assessment Numeric Evaluation; *VAS*, visual analog scale; *VR-12*, Veterans RAND 12-Item Health Survey; *PCS*, Physical Component Score; *MCS*, Mental Component Score; *IPDS*, Iowa Personality Disorder Screen; *PAS*, Personality Assessment Screener.
* $P < .05$ was defined as statistically significant.
† Significantly greater than in white patients.
‡ Significantly greater than in African American patients.
§ Significantly greater than in Asian patients.
‖ No paired differences were significant on post hoc analysis ($P > .08$).

Discussion

The purpose of this investigation was to assess the association of race with patient demographic characteristics, number of dislocations prior to presentation, preoperative PROs, and clinical, radiographic, and intraoperative findings in patients undergoing shoulder stabilization surgery. We correctly hypothesized that minority groups would have worse preoperative PROs and worse pathology at the time of surgery than white patients. In our subgroup analysis, race was an independent risk factor for articular cartilage lesions, Hill-Sachs lesions, and glenoid bone loss > 10%. Meanwhile, a higher DCI score was predictive of glenoid bone loss > 10%.

Overall, US minority patients had more dislocations prior to surgery, which coincided with more frequent glenoid bone loss, articular cartilage lesions, and Hill-Sachs lesions. An increased number of dislocations has previously been shown to be associated with increased intra-articular pathology and eventual arthritis. Studies by Milano et al[26] and Griffith et al[9] both showed an increased frequency of glenoid bone loss with an increased number of dislocations, whereas other studies have shown increased frequencies of Hill-Sachs lesions and anterior labrum periosteal sleeve avulsion (ALPSA) lesions with recurrent dislocations.[10,11,20,35,37] The underlying cause of the racial discrepancies seen in our study is undoubtedly multifactorial and is likely a dynamic interplay among access to care, cultural attitudes toward medical care, biases of providers, and other socioeconomic factors.

Access to orthopedic care is affected by several socioeconomic factors. Previous research has looked at the effect of insurance status and how this may impact the ability to receive care.[7,17,27,30,31] For example, Pierce et al[31] called practices to schedule an appointment for a fictitious 14-year-old male patient with an anterior cruciate ligament injury; they found that 90% of practices offered a visit within 2 weeks when private insurance was given as the type of insurance as opposed to 14% when Medicaid was used. Many practices also do not accept Medicaid, limiting access to care and possibly making patients travel farther to see a surgeon in some locations. Minority patients in our study had a significantly lower proportion of private insurance and higher DCI scores, suggestive of lower socioeconomic status. An interesting finding was that neither DCI score nor insurance carrier was an independent predictor of higher dislocation rates or intra-articular cartilage lesions, possibly signifying a greater impact of race-based differences than economic factors. Compared with economic factors, research on access to orthopedic care based

Table IV Multivariate analysis of factors contributing to presence of articular cartilage lesions at time of surgery

	Odds ratio	95% CI	*P* value
Variables included in model			
Age	1.03	1.01-1.04	.002
Male sex	1.76	1.26-2.48	.001
Injured dominant shoulder	1.35	1.04-1.76	.03
Racial/ethnic group			
White	Reference category		
African American	2.23	1.27-3.90	.005
Asian	1.34	0.72-2.48	.35
Hispanic	1.04	0.50-2.15	.92
Variables not included in model			
Distressed Communities Index	—	—	.86
Insurance carrier	—	—	.31

CI, confidence interval.

Table V Multivariate analysis of factors contributing to presence of Hill-Sachs lesions at time of surgery

	Odds ratio	95% CI	*P* value
Variables included in model			
Age	1.01	1.00-1.03	.11
Male sex	1.88	1.32-2.67	<.001
Injured dominant shoulder	1.34	1.01-1.76	.04
Racial/ethnic group			
White	Reference category		
African American	1.74	0.97-3.14	.06
Asian	2.67	1.31-5.48	.007
Hispanic	1.17	0.55-2.49	.69
Variables not included in model			
Distressed Communities Index	—	—	.86
Insurance carrier	—	—	.23

CI, confidence interval.

on race is more limited. Using emergency department return rates for the same fracture in children aged $\leq$ 17 years, Dy et al[7] reported significantly greater return rates for nonwhite or unidentified-race patients.

Attempts to analyze health care disparities in the field of orthopedics have largely been assessed in total joint arthroplasty patients, based primarily on utilization rates. In an analysis of data from 8 state inpatient databases from 2001 to 2008, Zhang et al[39] found lower TKA utilization rates among African American, Hispanic, Asian, Native American, and mixed-race patients than white patients. In another study, Singh and Ramachandran[34] found significantly a lower utilization rate for total shoulder arthroplasty in African American vs. white patients, with increasing disparity throughout the study period. Attempts to understand the cause of this disparity have recently been undertaken. Studies have found that racial disparities in surgical utilization may be due to a greater reliance on self-care measures, lack of education about the surgical intervention and postoperative outcomes, and perceptions of the helpfulness of prayer.[1,12,15,16,21,29] Our study did not look into these potential cultural differences as data regarding patient attitudes toward surgery and providers were not collected. In an attempt to assess the effect of patient education, a recent randomized controlled trial by Ibrahim et al[14] showed that educational intervention can significantly increase the willingness to consider TKA and attend an orthopedic consultation. Further study into patient education strategies in the younger patient population affected by shoulder instability is warranted.

The strengths of our study include the multicenter, multi-surgeon, private and academic practices and the diverse geographic regions, which likely make the study generalizable. However, there are several limitations in this study. The purpose of the MOON Shoulder Instability cohort is to collect outcomes after shoulder stabilization surgery prospectively, and because of this, we were unable to determine the patients' specific reasons for any potential delay in surgery or obtaining access to care. We were also unable to assess the incidence of surgical correction vs. nonsurgical management in the treatment of shoulder instability as only patients electing to undergo surgery were

Table VI Multivariate analysis of factors contributing to bone loss > 10% at time of surgery

	Odds ratio	95% CI	*P* value
Variables included in model			
Age	1.02	1.00-1.05	.07
Male sex	6.02	2.16-16.75	.001
Injured dominant shoulder	1.47	0.94-2.30	.09
Racial/ethnic group			
White	Reference category		
African American	2.32	1.27-3.90	.02
Asian	2.14	0.72-2.48	.07
Hispanic	0.93	0.27-3.17	.90
Distressed Communities Index	1.01	1.00-1.02	.03
Variable not included in model			
Insurance carrier	—	—	.10

CI, confidence interval.

enrolled in the prospective cohort. Additionally, instability events were patient-reported events and subject to recall bias. The patient population was overwhelmingly white, which may be further evidence of racially based disparity in access to care. Finally, because of the cross-sectional nature of the study, we cannot determine whether bone loss was due to the initial injury vs. recurrence, and we do not know whether differences in intra-articular pathology correspond with inferior surgical outcomes for this group of patients.

Conclusion

In this analysis of the data from the MOON Shoulder Instability Group, we found that minority race was associated with an increased number of dislocations prior to surgery, as well as an increased frequency of articular cartilage lesions and increased prevalence of Hill-Sachs lesions at the time of surgery, and both race and an increased DCI score were associated with glenoid bone loss > 10%. Race may influence the timing and whether patients undergo surgery for shoulder instability. Further studies should aim to assess reasons for potential variations in presentation and surgical management, in addition to identifying ways to address the disparities, such as educational tools for patients, increased access for Medicaid patients, and a better understanding of patient preferences.

Disclaimer

This study was supported in part by research grants from the Orthopaedic Research & Education Fund.

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

References

1. Ang DC, Ibrahim SA, Burant CJ, Siminoff LA, Kwoh CK. Ethnic differences in the perception of prayer and consideration of joint arthroplasty. Med Care 2002;40:471-6. https://doi.org/10.1097/00005650-200206000-00004
2. Brophy RH, Beauvais RL, Jones EC, Cordasco FA, Marx RG. Measurement of shoulder activity level. Clin Orthop Relat Res 2005;439:101-8. https://doi.org/10.1097/01.blo.0000173255.85016.1f
3. Brophy RH, Hettrich CM, Ortiz S, Wolf BR. Patients undergoing shoulder stabilization surgery have elevated shoulder activity compared with sex- and age-matched healthy controls. Sports Health 2016;9:59-63. https://doi.org/10.1177/1941738116676810
4. Carmichael H, Moore A, Steward L, Velopulos CG. Disparities in emergent versus elective surgery: comparing measures of neighborhood social vulnerability. J Surg Res 2020;256:397-403. https://doi.org/10.1016/j.jss.2020.07.002
5. Charles EJ, Mehaffey JH, Hawkins RB, Fonner CE, Yarboro LT, Quader MA, et al. Socioeconomic Distressed Communities Index predicts risk-adjusted mortality after cardiac surgery. Ann Thorac Surg 2019;107:1706-12. https://doi.org/10.1016/j.athoracsur.2018.12.022
6. Duchman KR, Hettrich CM, Glass NA, Westermann RW, Wolf BR, Baumgarten K, et al. The incidence of glenohumeral bone and cartilage lesions at the time of anterior shoulder stabilization surgery: a comparison of patients undergoing primary and revision surgery. Am J Sports Med 2018;46:2449-56. https://doi.org/10.1177/0363546518781331
7. Dy CJ, Lyman S, Do HT, Fabricant PD, Marx RG, Green DW. Socioeconomic factors are associated with frequency of repeat emergency department visits for pediatric closed fractures. J Pediatr Orthop 2014;34:548-51. https://doi.org/10.1097/bpo.0000000000000143
8. Economic Innovation Group. The Distressed Communities Index. 2017, eig.org/dci. Accessed September 19, 2019
9. Griffith JF, Antonio GE, Yung PS, Wong EM, Yu AB, Ahuja AT, et al. Prevalence, pattern, and spectrum of glenoid bone loss in anterior shoulder dislocation: CT analysis of 218 patients. AJR Am J Roentgenol 2008;190:1247-54. https://doi.org/10.2214/ajr.07.3009

10. Gutierrez V, Monckeberg JE, Pinedo M, Radice F. Arthroscopically determined degree of injury after shoulder dislocation relates to recurrence rate. Clin Orthop Relat Res 2012;470:961-4. https://doi.org/10.1007/s11999-011-2229-8
11. Habermeyer P, Gleyze P, Rickert M. Evolution of lesions of the labrum-ligament complex in posttraumatic anterior shoulder instability: a prospective study. J Shoulder Elbow Surg 1999;8:66-74.
12. Hausmann LR, Mor M, Hanusa BH, Zickmund S, Cohen PZ, Grant R, et al. The effect of patient race on total joint replacement recommendations and utilization in the orthopedic setting. J Gen Intern Med 2010;25:982-8. https://doi.org/10.1007/s11606-010-1399-5
13. Hawkins RB, Mehaffey JH, Charles EJ, Kern JA, Schneider EB, Tracci MC. Socioeconomically Distressed Communities Index independently predicts major adverse limb events after infrainguinal bypass in a national cohort. J Vasc Surg 2019;70:1985-93.e8. https://doi.org/10.1016/j.jvs.2019.03.060
14. Ibrahim SA, Hanusa BH, Hannon MJ, Kresevic D, Long J, Kent Kwoh C. Willingness and access to joint replacement among African American patients with knee osteoarthritis: a randomized, controlled intervention. Arthritis Rheum 2013;65:1253-61. https://doi.org/10.1002/art.37899
15. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Variation in perceptions of treatment and self-care practices in elderly with osteoarthritis: a comparison between African American and white patients. Arthritis Rheum 2001;45:340-5.
16. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Differences in expectations of outcome mediate African American/white patient differences in "willingness" to consider joint replacement. Arthritis Rheum 2002;46:2429-35. https://doi.org/10.1002/art.10494
17. Iobst C, Arango D, Segal D, Skaggs DL. National access to care for children with fractures. J Pediatr Orthop 2013;33:587-91. https://doi.org/10.1097/BPO.0b013e31829b2da4
18. Jacobs CA, Christensen CP, Karthikeyan T. Patient and intraoperative factors influencing satisfaction two to five years after primary total knee arthroplasty. J Arthroplasty 2014;29:1576-9. https://doi.org/10.1016/j.arth.2014.03.022
19. Jha AK, Fisher ES, Li Z, Orav EJ, Epstein AM. Racial trends in the use of major procedures among the elderly. N Engl J Med 2005;353: 683-91. https://doi.org/10.1056/NEJMsa050672
20. Kim DS, Yoon YS, Yi CH. Prevalence comparison of accompanying lesions between primary and recurrent anterior dislocation in the shoulder. Am J Sports Med 2010;38:2071-6. https://doi.org/10.1177/0363546510371607
21. Kwoh CK, Vina ER, Cloonan YK, Hannon MJ, Boudreau RM, Ibrahim SA. Determinants of patient preferences for total knee replacement: African-Americans and whites. Arthritis Res Ther 2015; 17:348. https://doi.org/10.1186/s13075-015-0864-2
22. Lobo JM, Kim S, Kang H, Ocker G, McMurry TL, Balkrishnan R, et al. Trends in uninsured rates before and after Medicaid expansion in counties within and outside of the diabetes belt. Diabetes Care 2020; 43:1449-55. https://doi.org/10.2337/dc19-0874
23. Marshall T, Vega J, Siqueira M, Cagle R, Gelber JD, Saluan P. Outcomes after arthroscopic Bankart repair: patients with first-time versus recurrent dislocations. Am J Sports Med 2017;45:1776-82. https://doi.org/10.1177/0363546517698692
24. Mehaffey JH, Hawkins RB, Charles EJ, Sahli ZT, Schirmer BD, Hallowell PT. Socioeconomically distressed communities associated with long-term mortality after bariatric surgery. J Surg Res 2019;243: 8-13. https://doi.org/10.1016/j.jss.2019.04.081
25. Mehaffey JH, Hawkins RB, Charles EJ, Turrentine FE, Hallowell PT, Friel C, et al. Socioeconomic "Distressed Communities Index" improves surgical risk-adjustment. Ann Surg 2020;271:470-4. https://doi.org/10.1097/sla.0000000000002997
26. Milano G, Grasso A, Russo A, Magarelli N, Santagada DA, Deriu L, et al. Analysis of risk factors for glenoid bone defect in anterior shoulder instability. Am J Sports Med 2011;39:1870-6. https://doi.org/10.1177/0363546511411699
27. Newman JT, Carry PM, Terhune EB, Spruiell M, Heare A, Mayo M, et al. Delay to reconstruction of the adolescent anterior cruciate ligament: the socioeconomic impact on treatment. Orthop J Sports Med 2014;2: 2325967114548176. https://doi.org/10.1177/2325967114548176
28. Outerbridge RE. The etiology of chondromalacia patellae. J Bone Joint Surg Br 1961;43-b:752-7.
29. Parks ML, Hebert-Beirne J, Rojas M, Tuzzio L, Nelson CL, Boutin-Foster C. A qualitative study of factors underlying decision making for joint replacement among African Americans and Latinos with osteoarthritis. J Long Term Eff Med Implants 2014;24:205-12. https://doi.org/10.1615/jlongtermeffmedimplants.2014010428
30. Patterson BM, Draeger RW, Olsson EC, Spang JT, Lin FC, Kamath GV. A regional assessment of Medicaid access to outpatient orthopaedic care: the influence of population density and proximity to academic medical centers on patient access. J Bone Joint Surg Am 2014;96:e156. https://doi.org/10.2106/jbjs.m.01188
31. Pierce TR, Mehlman CT, Tamai J, Skaggs DL. Access to care for the adolescent anterior cruciate ligament patient with Medicaid versus private insurance. J Pediatr Orthop 2012;32:245-8. https://doi.org/10.1097/BPO.0b013e31824abf20
32. Rugg CM, Hettrich CM, Ortiz S, Wolf BR, Zhang AL. Surgical stabilization for first-time shoulder dislocators: a multicenter analysis. J Shoulder Elbow Surg 2018;27:674-85. https://doi.org/10.1016/j.jse.2017.10.041
33. Singh JA, Lu X, Rosenthal GE, Ibrahim S, Cram P. Racial disparities in knee and hip total joint arthroplasty: an 18-year analysis of national Medicare data. Ann Rheum Dis 2014;73:2107-15. https://doi.org/10.1136/annrheumdis-2013-203494
34. Singh JA, Ramachandran R. Persisting racial disparities in total shoulder arthroplasty utilization and outcomes. J Racial Ethn Health Disparities 2016;3:259-66. https://doi.org/10.1007/s40615-015-0138-3
35. Spatschil A, Landsiedl F, Anderl W, Imhoff A, Seiler H, Vassilev I, et al. Posttraumatic anterior-inferior instability of the shoulder: arthroscopic findings and clinical correlations. Arch Orthop Trauma Surg 2006;126:217-22. https://doi.org/10.1007/s00402-005-0006-4
36. Wolf BR, Uribe B, Hettrich CM, Gao Y, Johnson M, Kuhn JE, et al. Shoulder instability: interobserver and intraobserver agreement in the assessment of labral tears. Orthop J Sports Med 2018;6: 2325967118793372. https://doi.org/10.1177/2325967118793372
37. Yiannakopoulos CK, Mataragas E, Antonogiannakis E. A comparison of the spectrum of intra-articular lesions in acute and chronic anterior shoulder instability. Arthroscopy 2007;23:985-90. https://doi.org/10.1016/j.arthro.2007.05.009
38. Yu S, Mahure SA, Branch N, Mollon B, Zuckerman JD. Impact of race and gender on utilization rate of total shoulder arthroplasty. Orthopedics 2016;39:e538-44. https://doi.org/10.3928/01477447-20160427-14
39. Zhang W, Lyman S, Boutin-Foster C, Parks ML, Pan TJ, Lan A, et al. Racial and ethnic disparities in utilization rate, hospital volume, and perioperative outcomes after total knee arthroplasty. J Bone Joint Surg Am 2016;98:1243-52. https://doi.org/10.2106/jbjs.15.01009