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Original Research

Understanding Changing Demographic and Treatment Trends of Distal Radius Fractures: A TriNetX Database Contemporary Analysis of 32,912 Patients

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Purpose: Distal radius fractures (DRF) are among the most commonly encountered fractures. The population of the United States is rapidly growing, aging, and diversifying. This study was undertaken to better understand current incidences and treatment trends across all ages, gender, and races to inform resource allocation and to potentially address treatment inequities.
Methods: The TriNetX US Collaborative Network was queried for all patients diagnosed with DRFs from 2017 to 2022. Cohorts were defined by inclusion and exclusion of Current Procedural Terminology procedure codes and categorized into operative and nonsurgical groups. Statistical analysis was performed to determine differences in management among demographic groups across the 6-year time period.
Results: Incidence rates of operative intervention for DRF increased from 19.6% in 2017 to 23.6% in 2022. Incidence rates of operative intervention increased from 21.7% to 25.2% for females and from 15.3% to 19.7% for males. A bimodal distribution was observed in females with more fractures occurring in the pediatric and geriatric ages, but this distribution was not observed in males. All demographic groups had an overall higher incidence of nonsurgical intervention. Patients aged 40–64 years were more likely to undergo operative intervention than patients 18–39 years. Females were more likely to undergo operative intervention than males. White patients were more likely to undergo operative intervention than Black patients and Asian patients.
Conclusions: The incidence of DRFs continues to climb, as does their rate of operative management. The classic bimodal distribution was observed in females, but not males. However, differences in management of DRFs were also observed across different demographic groups with ongoing racial disparities. Future consideration should be taken into optimizing treatment disparities relative to demographic status.
Type of Study/Level of Evidence: Prognosis IV.

Distal radius fractures (DRFs) are among the most common fractures affecting adults with a previously reported incidence rate of 17.5%, along with a projected increase in coming years.[1] Traditionally, DRFs have been considered to have a bimodal age distribution, effecting predominantly the very young and the very old. Similarly, DRFs are considered more common in women than men.[2] However, the age and demographics of the United States population are changing rapidly, and new implications on gender, age, and racial disparities are not well understood relative to these common fractures. By 2060, it is projected that the United States will no longer have a single racial or ethnic majority (Fig. 1).[3] This changing demographic may impact our understanding of DRFs as current treatment paradigms are based on prior data and may

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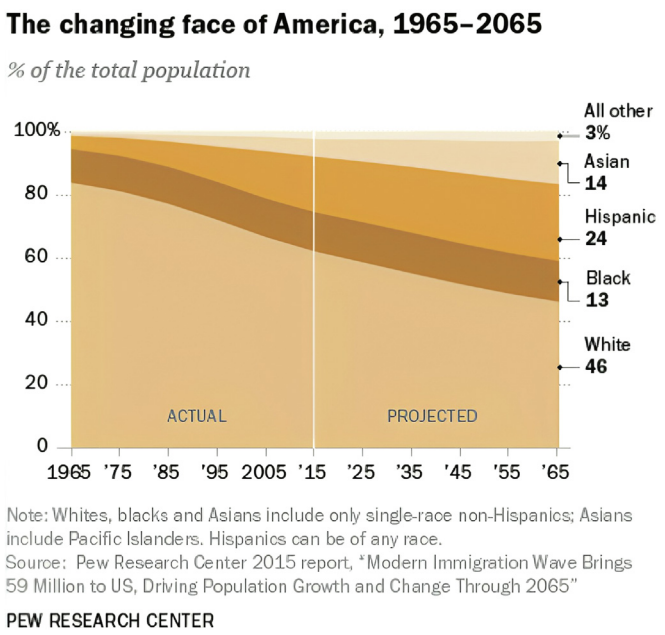

Figure 1. Demographic breakdown of US population by race from 1965 to 2015 with projected proportions to 2065.[3] (Reprinted with permission)

not be generalizable to today's rapidly diversifying populations.[1] As the United States continues to diversify, understanding how these DRFs present and are treated can better inform both resource allocation and identify treatment inequities by age, gender, and race.

The purpose of this study, using the TriNetX database, a global health research network, is to better understand contemporary incidences and demographics of DRFs, and how they are currently treated relative to age, gender, and race. Additionally, this study seeks to identify treatment patterns across demographic groups and inequalities in treatment that may be present.

Materials and Methods

A retrospective study was performed using the TriNetX US Collaborative Network, which was queried on August 21, 2023. The use of the TriNetX database does not involve patient identifiable information and is subsequently Institutional Review Board exempt.

Patient cohorts were defined using the International Classification for Disease, 10th Edition (ICD-10) diagnosis codes. All patients diagnosed with right or left DRF (ICD-10 code S52.531A and S52.532A, respectively) between January 1, 2017 and December 31, 2022 were included, resulting in a total of 32,912 patients.

Patient cohorts were subsequently defined by inclusion and exclusion of operative fixation procedures through use of the Current Procedural Terminology (CPT) system codes. The operative group contained CPT codes for the following conditions, percutaneous skeletal fixation of DRF (CPT 25606), open treatment with internal fixation of extra-articular DRF (CPT 25607), open treatment of intra-articular fracture with internal fixation of two fragments (CPT 25608), and open treatment of distal radius intra-articular fracture with internal fixation of three or more fragments (CPT 25609) resulting in 7,905 patients. The nonsurgical cohort was determined by exclusion of the aforementioned CPT codes (n = 25,007). CPT code inclusion/exclusion must have occurred within 4 weeks of DRF diagnosis.

Native Hawaiian/Pacific Islander and American Indian/Alaska Native racial groups were excluded from incidence rate calculations based on low sample sizes. Patients of unknown sex, ethnicity, and race were similarly removed from calculations. In this study, patient sex refers to the sex (male or female) given to the patient at birth based on external anatomy.

About TriNetX

TriNetX is a global research network containing data from over 170 health care organizations and over 400 million patients.[4] Variables captured include deidentified aggregate patient data of procedures, diagnoses, medications, vitals, genomics, and demographics. Health care organizations (HCOs) that participate in the TriNetX network provide health care data as a deidentified, pseudoanonymized, or limited data set (depending on local privacy regulations), and HCOs grant the use of that data, for research purposes, on the TriNetX platform. In exchange for contributing their data, HCOs incur no financial costs and receive data query, analytic, and visualization capabilities as well as the hardware needed to execute the software. The process by which data are deidentified has been attested to through a formal determination by a qualified expert as defined in Section §164.514(b)(1) of the Health Insurance Portability and Accountability Act Privacy Rule and is therefore considered Health Insurance Portability and Accountability Act compliant.[5]

Statistics

Statistical analysis consisted of cohort comparisons using z-tests to determine significant differences between operative and nonsurgical groups among different demographic categories, including age, sex, ethnicity, and race. *P* values were also used to determine statistical significance differences in incident rates between 2017 and 2022. Odds ratios (ORs) with 95% confidence intervals (CIs) for the outcome of surgery were subsequently determined for demographic cohorts. For all analyses, a two-tailed *P* value $\leq$ .05 was considered significant.

Results

Fracture demographics

A total of 32,912 DRFs were recorded between 2017 to 2022 with annual increases across years. Patient age ranged from 0 to 90 years with mean age of 54.8 $\pm$ 25.3 years. A bimodal distribution pattern was observed in female patients, with peaks at 15 and 70 years of age, but this trend was not observed in males (Fig. 2). Females also had a higher overall frequency of DRF than males (70.0% vs 30.0%). Not Hispanic or Latino patients averaged 63.4% of DRFs, whereas Hispanic or Latino averaged 9.9%. White patients account for most DRFs across racial groups (75.5%), whereas Black and Asian patients accounted for 6.5% and 3.7%, respectively. Native Hawaiian and American Indian patients represented 0.3% and 0.4%, respectively (Table 1).

Treatment patterns by age

The incidence rate of operative intervention for DRF increased from 19.6% in 2017 to 23.6% in 2022 ($P < .0001$) (Fig. 3). The mean age for operative intervention was 58.8 $\pm$ 18.8 years in contrast to 53.5 $\pm$ 27 years for nonsurgical management (Tables 2,3).

Patients aged 18–39 and 40–64 years experienced significant increases in incidence rates of operative intervention from 14.9% to 33.3% ($P < .0001$) and 30.4% to 33.3% ($P = .0357$), respectively.

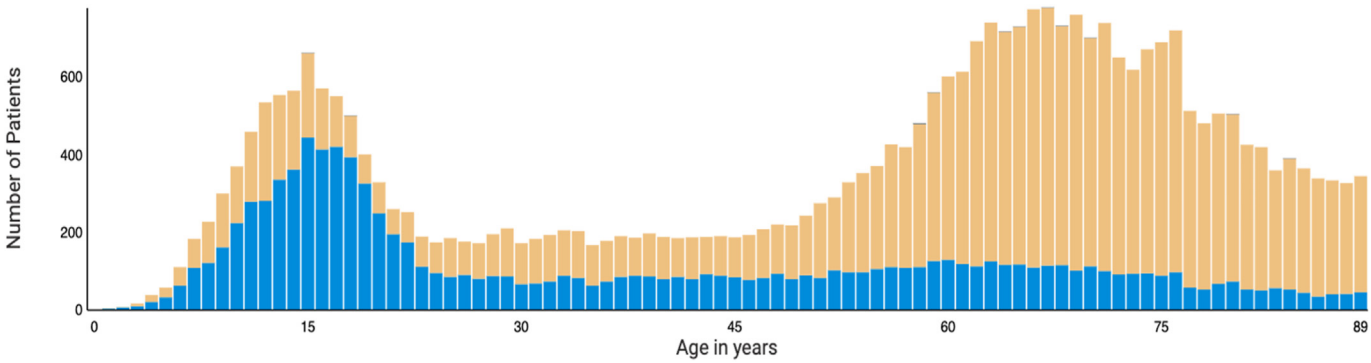

Figure 2. Age distribution of distal radius fractures occurring between 2017 to 2022.[4] Male: Blue, Female: Orange.

Table 1
Distal Radius Fracture Demographics*

Year	2017	2018	2019	2020	2021	2022	2017–2022
Total Patients	5,217	5,687	6,068	5,326	6,162	6,197	32,912
Age							
Mean Age ± SD	55.5 ± 25.7	55.9 ± 25.4	55.1 ± 25.4	56.6 ± 24.9	53.8 ± 25.2	59 ± 18.7	54.8 ± 25.3
0–17 (%)	385 (**7.4%**)	471 (**8.5%**)	602 (**10.0%**)	372 (**7.0%**)	674 (**10.9%**)	738 (**11.9%**)	3134 (**9.5%**)
18–39 (%)	1011 (**19.4%**)	878 (**15.4%**)	844 (**13.9%**)	731 (**13.7%**)	829 (**13.5%**)	789 (**12.7%**)	4896 (**14.9%**)
40–64 (%)	1258 (**24.1%**)	1483 (**26.1%**)	1666 (**27.4%**)	1508 (**28.3%**)	1773 (**28.8%**)	1882 (**30.4%**)	9057 (**27.5%**)
65–90 (%)	2563 (**49.1%**)	2847 (**50.0%**)	2956 (**48.7%**)	2715 (**51.0%**)	2886 (**46.8%**)	2788 (**45.0%**)	15825 (**48.1%**)
Sex							
Female (%)	3493 (**67.0%**)	4018 (**70.7%**)	4229 (**69.7%**)	3876 (**72.8%**)	4382 (**71.1%**)	4371 (**70.5%**)	23048 (**70.0%**)
Male (%)	1724 (**33.0%**)	1666 (**29.3%**)	1835 (**30.3%**)	1448 (**27.2%**)	1777 (**28.9%**)	1824 (**29.5%**)	9851 (**30.0%**)
Ethnicity							
Not Hispanic or Latino (%)	3271 (**62.7%**)	3533 (**62.1%**)	3774 (**62.2%**)	3505 (**65.8%**)	4003 (**65.0%**)	3908 (**63.1%**)	20864 (**63.4%**)
Hispanic or Latino (%)	627 (**8.9%**)	589 (**10.4%**)	658 (**11.%**)	410 (**8.8%**)	670 (**10.8%**)	665 (**10.7%**)	3260 (**9.9%**)
Race							
White (%)	3951 (**75.7%**)	4275 (**75.2%**)	4576 (**75.4%**)	4107 (**77.1%**)	4660 (**75.6%**)	4639 (**74.9%**)	24849 (**75.5%**)
Black (%)	365 (**6.9%**)	408 (**7.2%**)	401 (**6.6%**)	313 (**5.9%**)	369 (**6.0%**)	362 (**5.8%**)	2130 (**6.5%**)
Asian (%)	182 (**3.5%**)	197 (**3.5%**)	219 (**3.6%**)	206 (**3.9%**)	233 (**3.8%**)	264 (**4.3%**)	1227 (**3.7%**)
Native Hawaiian or other Pacific Islander (%)	13 (**0.2%**)	18 (**0.3%**)	22 (**0.4%**)	14 (**0.3%**)	15 (**0.2%**)	23 (**0.4%**)	99 (**0.3%**)
American Indian or Alaska Native (%)	22 (**0.4%**)	20 (**0.3%**)	17 (**0.3%**)	23 (**0.4%**)	22 (**0.4%**)	21 (**0.3%**)	116 (**0.4%**)

SD, standard deviation.
* Data in table correspond to total number of distal radius fractures between 2017 and 2022 with respective demographic breakdown. Corresponding percentage of each demographic group to total patient count included in bold.

Patients aged 0–17 and 65–90 years experienced insignificant increases from 3.3% to 5.3% ($P = .0969$) and from 20.7% to 22.2% ($P = .2585$), respectively (Fig. 4). Patients aged 0–17 years were less likely to undergo operative intervention than patients aged 18–39 years (OR = 0.165, 95% CI 0.144–0.189, $P < .0001$). Patients aged 40–64 years were more likely to undergo operative intervention than patients 18–39 years (OR = 1.476, 95% CI 1.366–1.595, $P < .0001$) (Table 2). There was no difference in likelihood of operative management when comparing patients aged 18–39 to 65–90 years (OR = 0.955, 95% CI 0.886–1.029, $P = .2063$). There was a statistically significant difference in incidence rates comparing operative to nonsurgical management across all age groups ($P < .0001$) (Table 3).

Treatment patterns by gender

Incidence rates of operative intervention increased for females and males from 21.7% to 25.2% ($P = .0004$) and from 15.26% to 19.7% ($P = .0004$), respectively (Fig. 4). Females were more likely to undergo operative intervention than males (OR = 0.684, 95% CI 0.647–0.723, $P < .0001$) (Table 2). The differences in incidence rates of operative and nonsurgical cohorts among genders were statistically significant ($P < .0001$) (Table 3).

Treatment patterns by race

Not Hispanic or Latino and Hispanic or Latino groups experienced increases in incidence rates of operative intervention from 21.2% to 25.4% ($P < .0001$) and from 21.9% to 25.7% ($P = .0026$), respectively (Fig. 5). There was no significant difference in likelihood of operative intervention between ethnic groups (OR = 1.025, 95% CI 0.945–1.112, $P = .7355$) (Table 2). Both ethnic groups had statistically significant differences in incidence rates comparing operative intervention to nonsurgical management (Table 3).

Incidence rates of operative intervention increased from 21.2% to 25.6% ($P < .0001$) for White patients and from 14.8% to 21.6% ($P = 0.0183$) for Black patients. Asian patients experienced increases from 18.1% to 21.6% ($P = 0.3735$); however, the result was not statistically significant (Fig. 6). White patients were more likely to undergo operative intervention compared to Black patients (OR = 0.749, 95% CI 0.673–0.834, $P < .0001$) and Asian patients (OR = 0.846, 95% CI 0.793–0.979, $P = .0402$) (Table 2). The difference in

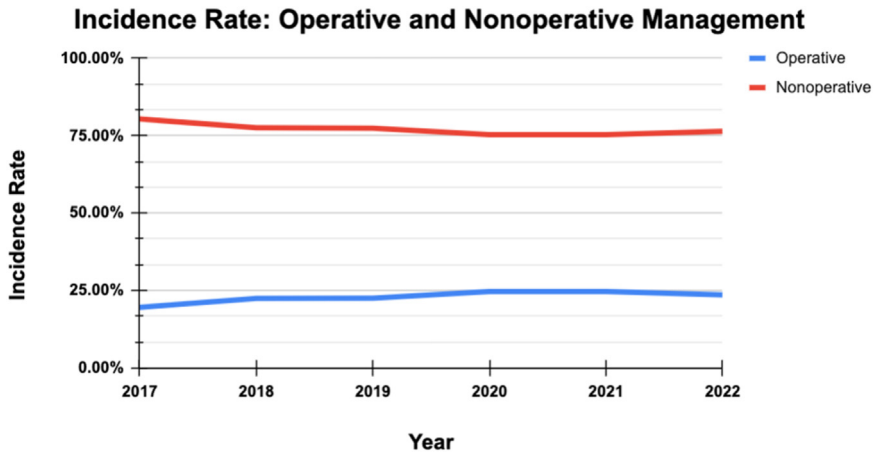

Figure 3. Line graph of incidence rates for operative and nonoperative management of distal radius fractures from 2017 to 2022.

incidence rates of operative and nonsurgical management among all racial groups was statistically significant ($P < .0001$) (Table 3).

Discussion

The study yielded a number of demographic and incidence findings, including an increasing overall incidence of DRFs that occurs more often in women than men and an increasing operative intervention; however, disparities were noted among different races. Moreover, the study found that female patients with DRFs continue to have a bimodal distribution. In contrast, the incidence of DRFs in male patients spiked during childhood but subsequently equilibrated thereafter, including in their elderly years.

Current guidelines for treatment of DRF have been described in the Appropriate Use Criteria approved by the American Academy of Orthopedic Surgeons. Based on these guidelines, the recommendation for treatment is determined based on patient health, activity level, mechanism of injury, and fracture type.[6] Nevertheless, most recommendations are graded as inconclusive with none of the 29 recommendations graded as strong. Additionally, there has been interest in more aggressive fracture fixation with the goal of a quicker recovery to preserve the ability of patients to return to and maintain day to day activities. The introduction of volar locking plates has particularly spurred this interest with quicker rates of recovery across adult ages groups.[7] As a result, increases in rates of operative management have been identified in recent years.[7–9]

A recent review of Medicare data performed by Chung et al[8] found that although closed treatment was the most prevalent form of fracture management, use of this treatment method decreased from 82% to 70%, whereas internal fixation rates increased. More recent studies found operative rates to be as high as 16% in 2013 and 20% in 2014.[7,9] As a result, focus has begun to shift toward identifying variations in treatment methods between demographic groups.[10] This study similarly found an increase in operative rates from 19.6% in 2017 to 23.6% in 2022 in addition to individual increases across multiple demographic groups (Table 2).

Several studies have been conducted examining trends in operative and nonsurgical management for DRF across all age groups.[11,12] Nonelderly patients were more likely to undergo operative intervention.[11] In contrast, nonsurgical management within the pediatric population is more often used based on their inherent greater potential for remodeling.[12] Likewise, this study identified an operative rate of 5.3% for pediatric patients in contrast to older age groups with operative rates ranging from 24.8% to 34.0% (Table 2). Most interesting, the classic bimodal distribution was evident among female patients but was not identified in male patients (Fig. 2), which is in contrast to prior categorizations of DRF distributions.[9]

Female sex has been associated with reduced use of orthopedic care for trauma.[13] In a study by Zelle et al,[14] females had a lower rate of surgical intervention for calcaneus fracture compared to males. Similarly, Razmjou et al[15] found reduced surgical referral rates for women after shoulder injury compared to males. Similar trends have been studied within elective orthopedic procedures, including carpal tunnel release and lumbar spine surgery.[16,17] In contrast, this study found that females have a higher likelihood of operative intervention for DRF compared to males (Table 2).

Widespread reporting of racial bias has been identified across multiple facets of medicine with a recent focus on disparate outcomes and lack of equitable delivery of health care.[9] Minorities have been generally found to receive lower quality medical care and/or have less access to care compared to the White patient population.[18] In this study, no statistical differences in rates of operative intervention between ethnic groups were identified. However, statistically significant differences were found among racial groups, as White patients were more likely to undergo operative intervention for DRF compared to Black and Asian patients. Floyd et al[19] found similar findings regarding proximal humerus fractures with White patients more likely to receive operative fixation within 60 days of inciting injury compared to racial counterparts. This overall trend is in line with various studies examining racial disparities within orthopedic trauma.[14,20] Possible inferences as to why these disparities exist include implicit bias by hospital staff and physicians, patients' social factors, and structural racism within the health care system. Critical self-analysis of resource allocation and treatment indications is needed to answer the cause of this ongoing disparity.

Through the use of the TriNetX database, patient data from 59 HCOs across the country were used creating a heterogenous assortment of patient data otherwise unavailable to single institution studies. However, this study is not without limitations. The data are without indication of mechanism of injury, fracture pattern, functional status of patient, and functional outcomes. Therefore, the study cannot comment on the indications and appropriateness of the different interventions. Furthermore, the statistical analysis is not adjusted for socioeconomic factors, such as access to care, insurance status, income, and comorbid conditions.

Distal radius fractures are among the most common fractures with incidence rates continuing to rise. However, the bimodal incidence by age of DRFs that is often cited was not evident among

Table 2
Rate of Operative Management for Distal Radius Fractures*

Year	2017	2018	2019	2020	2021	2022	2017–2022	*P* Value Incident Rate 2017 vs Incident Rate 2022†	Odds Ratio Operative Management (95% CI) (2017–2022)†	*P* Value Odds Ratio†
Total Patients	19.6%	22.5%	22.5%	24.7%	24.7%	23.6%	24.0%	< .0001		
Age										
Mean Age ± SD	60.9 ± 18.5	60.9 ± 19	60.5 ± 17.7	54.3 ± 25.4	56.7 ± 18.6	55.1 ± 18.6	58.8 ± 18.8			
0–17	3.3%	5.7%	3.1%	6.7%	6.3%	5.4%	5.3%	.0969	0.165 (0.144–0.189)	< .0001
18–39	14.9%	19.9%	24.2%	30.1%	30.5%	33.3%	25.7%	< .0001	Reference	
40–64	30.4%	31.2%	32.3%	33.2%	33.4%	33.3%	34.0%	.0357	1.476 (1.366–1.595)	< .0001
65–90	20.7%	24.2%	24.3%	24.7%	25.0%	22.2%	24.8%	.2585	0.955 (0.886–1.029)	.2063
Sex										
Female	21.7%	24.6%	24.7%	26.1%	26.4%	25.2%	26.1%	.0004	Reference	
Male	15.3%	17.3%	17.6%	21.0%	20.4%	19.7%	19.2%	.0004	0.684 (0.647–0.723)	< .0001
Ethnicity										
Not Hispanic or Latino	21.1%	23.6%	24.3%	25.0%	25.7%	25.2%	25.4%	< .0001	Reference	
Hispanic or Latino	21.9%	20.2%	21.1%	28.8%	26.0%	29.3%	25.7%	.0026	1.025 (0.945–1.112)	.7355
Race										
White	21.2%	23.9%	24.5%	26.0%	25.6%	25.5%	25.6%	< .0001	Reference	
Black	14.8%	20.8%	17.5%	21.1%	22.8%	21.5%	20.5%	.0183	0.749 (0.673–0.834)	< .0001
Asian	18.1%	17.8%	21.5%	25.2%	25.8%	21.6%	23.0%	.3735	0.846 (0.793–0.979)	.0402

SD, standard deviation.
* Rate of operative management for distal radius fractures between 2017 to 2022 with respective demographic breakdown.
† *P* values comparing incidence rates from 2017 to 2022 and odds ratio comparing likelihood of operative management within individual demographic categories included.

Table 3
Rate of Nonoperative Management for Distal Radius Fractures*

Year	2017	2018	2019	2020	2021	2022	2017–2022	*P* Value Incidence Rates Operative vs Nonoperative Management (2017–2022)†
Total Patients	80.41%	77.55%	77.46%	75.31%	75.35%	76.42%	75.98%	< .0001
Age								
Mean Age ± SD	54.2 ± 26.9	54.6 ± 26.7	53.5 ± 27	55.7 ± 25.5	53 ± 26.9	52.6 ± 26.9	53.5 ± 27	
0–17	96.7%	94.3%	96.9%	93.3%	93.7%	94.6%	94.7%	< .0001
18–39	85.1%	80.1%	75.8%	69.9%	69.5%	66.7%	74.3%	< .0001
40–64	69.6%	68.8%	67.7%	66.8%	66.6%	66.7%	66.0%	< .0001
65–90	79.3%	75.8%	75.7%	75.3%	75.0%	77.8%	75.2%	< .0001
Sex								
Female	78.3%	75.4%	75.3%	73.9%	73.6%	74.8%	73.9%	< .0001
Male	84.7%	82.7%	82.4%	79.0%	79.6%	80.3%	80.8%	< .0001
Ethnicity								
Not Hispanic or Latino	78.9%	76.4%	75.7%	75.0%	74.3%	74.8%	74.6%	< .0001
Hispanic or Latino	78.1%	79.8%	78.9%	71.2%	74.0%	70.7%	0.8%	< .0001
Race								
White	78.8%	76.1%	75.5%	74.0%	74.4%	74.5%	74.4%	< .0001
Black	85.2%	79.2%	82.5%	78.9%		78.5%	79.5%	< .0001
Asian	81.9%	82.2%	78.5%	74.8%	74.2%	78.4%	77.0%	< .0001

SD, standard deviation.
* Rate of nonoperative management for distal radius fractures between 2017 to 2022 with respective demographic breakdown.
† *P* values comparing operative to nonoperative management within demographic categories included.

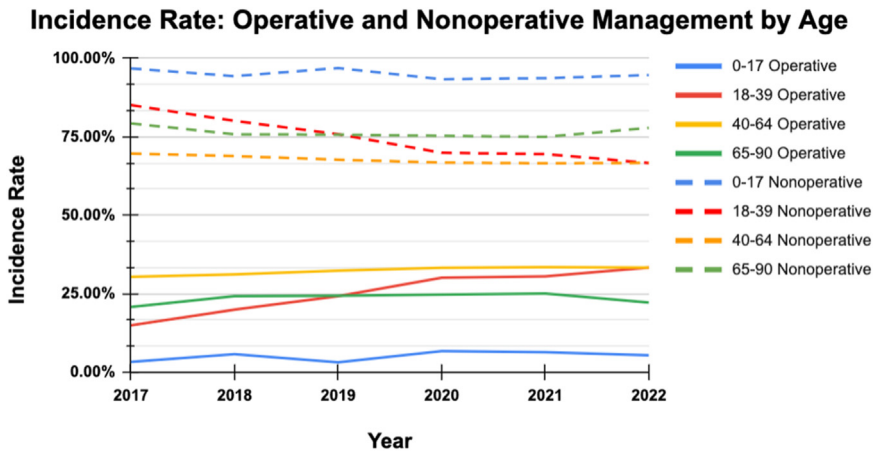

Figure 4. Line graph of incidence rates for operative and nonoperative management of distal radius fractures by age group from 2017 to 2022.

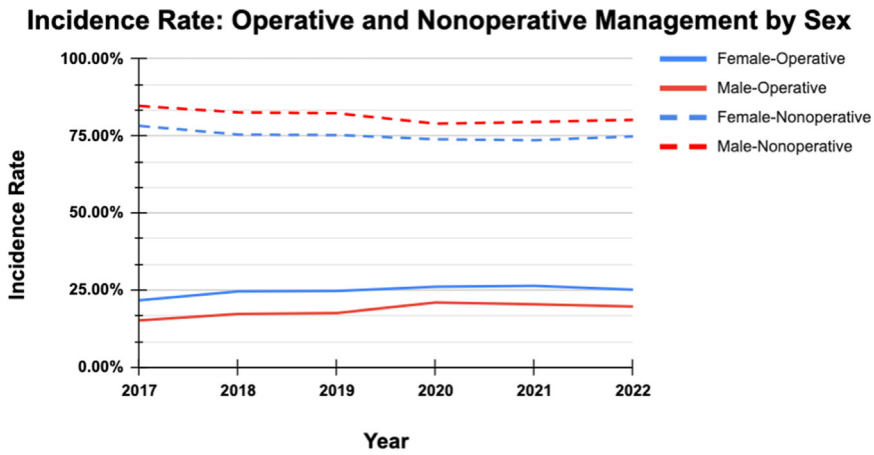

Figure 5. Line graph of incidence rates for operative and nonoperative management of distal radius fractures by sex from 2017 to 2022.

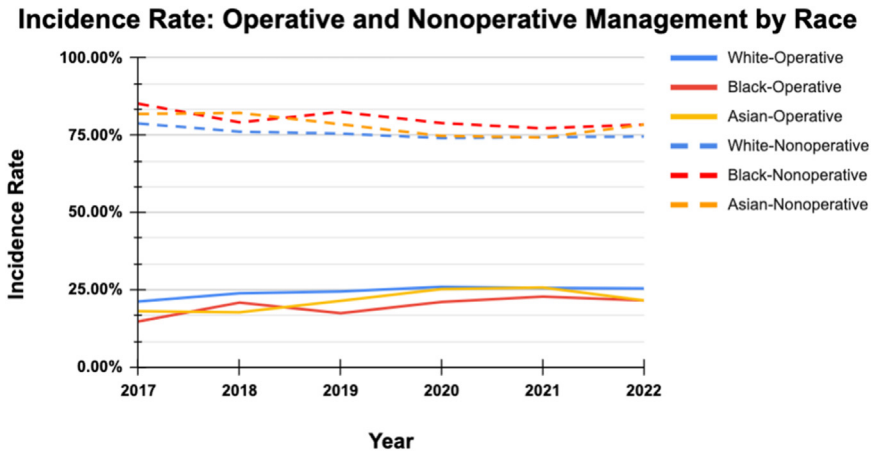

Figure 6. Line graph of incidence rates for operative and nonoperative management of distal radius fractures by race from 2017 to 2022.

male patients, but was present in female patients. Along with the increase, more surgeons are opting to indicate operative fixation relative to nonsurgical treatment. Yet, disparities among different demographic groups have been identified with respect to age group, gender, and race, with White patients being more often treated operatively than Black and Asian patients. Future consideration should be taken into optimizing treatment disparities relative to demographic status.

Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

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