



AOA Critical Issues in Education

Trends in Orthopaedic Surgery Fellowship Match Among Female Residents: Discrepancies in Sex Diversity by Subspecialty

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Introduction: There is a historic sex imbalance in the field of orthopaedic surgery in the United States, with female physicians being vastly underrepresented. In addition, this sex imbalance is particularly pronounced in certain subspecialties. As such, we sought to analyze the distribution of graduating female residents and their fellowship match trends from 2017 to 2022.

Methods: The American Medical Association Fellowship and Residency Electronic Interactive Database was used to identify all orthopaedic surgery residency programs in the United States during the 2016 to 2017 and the 2021 to 2022 academic years. The data were supplemented with the Accreditation Council for Graduate Medical Education (ACGME) Data Book to include data on all ACGME-accredited programs in 2017 and 2022. The percentage of female orthopaedic surgery residents matching into each subspecialty was calculated. Continuous data were analyzed with independent *t* test, and significance was set at $p < 0.05$.

Results: From 2017 to 2022, there has been a significant increase in the percentage of female residents matching in orthopaedic surgery fellowships (14.6% vs. 19.5%, $p < 0.001$). In the orthopaedic hand subspecialty, 24 (15.8%) female residents matched into a hand fellowship in 2017 vs. 56 (35.2%) in 2022 ($p < 0.001$). Spine, trauma, adult reconstruction, oncology, pediatrics, foot and ankle, shoulder and elbow, and sports medicine fellowships have not seen a significant change in the distribution of female residents matching over the past 5 years.

Conclusion: Between 2017 and 2022, the total number of female orthopaedic surgery fellows increased, and there was significant growth in the percentage of matched female fellows in the subspecialty of hand. Other orthopaedic subspecialties including spine, trauma, adult reconstruction, oncology, pediatrics, foot and ankle, shoulder and elbow, and sports medicine have seen no significant change in the distribution of women fellows over the past 5 years. Further investigation is warranted to determine factors leading to growth in certain fellowships among female residents to encourage sex diversity among all subspecialties in orthopaedic surgery.

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Introduction

Historically, the field of orthopaedic surgery in the United States has exhibited a significant sex imbalance, with an underrepresentation of female surgeons. This disparity persists today, with the percentage of female orthopaedic surgeons remaining among the lowest across all medical specialties¹. In 2020, the percentage of female orthopaedic surgeons practicing in the United States stood at only 6%, and the current percentage of female orthopaedic residents in ACGME-accredited programs in the United States is 19%². These numbers remain low, although 53% of medical students enrolled in 2022 identified as female³.

In addition, the field of orthopaedic surgery is trending toward more surgeons pursuing subspecialization and seeking fellowship training after residency. A study conducted by Horst et al. revealed that from 2003 to 2013, the percentage of orthopaedic surgeons pursuing fellowship gradually increased from 76% to 90% by 2013⁴. In addition to the trend of increasing numbers of applicants to fellowship programs, the number of positions available for subspecialty training has also increased over time. Between 2010 and 2017, the number of fellowship positions increased in all subspecialties except for spine and trauma. The largest increase in both applicants and positions was in adult reconstruction³.

As the field of orthopaedic surgery is becoming increasingly more specialized, it is important to evaluate the diversity of each of these subspecialties and think critically about what may be driving continued sex disparities in specific orthopaedic subspecialties. The proportion of female orthopaedic surgery residents applying to fellowships ranges between 7% and 10% of all fellowship applicants between 2010 and 2014⁵. This sex disparity is particularly pronounced in specific subspecialties, such as spine surgery, where female fellow representation has been previously reported at only 3%⁵. Current literature attributes the lack of female representation in orthopaedic surgery to various factors, including the absence of female mentors and leaders within the field⁶. Notably, Bratsceu et al. conducted a survey of female orthopaedic surgery residents to investigate the factors influencing their selection of specific specialties, emphasizing the significance of interest, exposure, and mentorship from females in the field as determining factors⁶. However, the recent trends of orthopaedic residents matching into fellowship by sex have not been described in the literature. The purpose of this study was to understand the current subspecialty distribution of graduating female residents and the fellowship selection trends among graduating female orthopaedic surgery residents from 2017 to 2022.

Methods

The American Medical Association Fellowship and Residency Electronic Interactive Database was used to identify all orthopaedic surgery residency programs in the United States during the 2016 to 2017 and the 2021 to 2022 academic years. All data for this study were collected from December 2022 to May 2024 from residency programs and hospital websites, social media, and contacting orthopaedic surgery residency programs directly when data could not be found online. Fellowship

matches for the classes of 2017 and 2022 were collected from each residency program and recorded by sex. The data were supplemented with the ACGME Data Book, which provides data on residents and fellows in ACGME-accredited programs to include data on all ACGME-accredited programs in 2017 and 2022. The total number of fellows, total number of female fellows, and the distribution of females per orthopaedic subspecialty were calculated. Female residents matched into every subspecialty in both 2017 and 2022 academic years. In addition, the mean geographic distribution of female fellows by subspecialty was calculated based on the National Resident Matching Program (NRMP) geographic distinction. Continuous data were analyzed with independent *t* test, and categorical data were analyzed with chi-square tests. For all statistical tests, significance was set at $p < 0.05$.

Results

Data were collected for a total of 617 (75%) graduating residents in 2017 and 726 (81%) graduating residents in 2022. From this cohort, the percentages of female residents of all graduating residents were calculated. Only the subspecialty of hand had a significant increase in the number of female residents between 2017 and 2022 (24 [15.9%] vs. 56 [35.2%], $p < 0.001$), and spine (2 [6.25%] vs. 7 [8.54], $p = 0.191$), trauma (8 [19.1%] vs. 15 [38.5%], $p = 0.261$), adult reconstruction (11 [11.7%] vs. 12 [8.70%] $p = 0.869$), oncology (3 [16.7%] vs. 4 [28.6%], $p = 0.846$), pediatrics (14 [35.9%] vs. 15 [38.4%], $p = 0.832$), sports medicine (23 [11.3%] vs. 27 [12.1%], $p = 0.931$), and foot and ankle (5 [14.3%] vs. 5 [15.5%], $p = 0.942$) have not seen a statistically significant change in the number of female residents matched over the past 5 years (Fig. 1). In 2022, 19.5% of graduating residents from ACGME-accredited residency programs in the United States were female. The subspecialties with the highest percentages of female residents entering into fellowship were pediatrics (38.5%), trauma (39.5%), and hand (35.2%). In the subspecialties of pediatrics, hand, oncology, and trauma, the proportion of female residents entering was 19.5% or higher, surpassing or matching the percentage of female residents graduating that year (Figs. 2 and 3). In 2017, the subspecialties with the highest percentage of female residents were pediatrics (35.9%), oncology (16.7%), and trauma (19.0%). The average percentage of graduating female residents was 14.6% in 2017. Hand, oncology, trauma, and pediatrics had a percentage of matching female residents greater than 14.6%. Between 2017 and 2022, there has been a significant increase in the total number of female fellows in orthopaedic surgery (90 [14.6%] vs. 141 [19.5%], $p < 0.001$).

In addition, the distribution of graduating female residents and their selection of fellowships was calculated out of the total number of graduating female residents. Higher percentages of female residents entered fellowships in hand (26.7%), sports (25.6%), and pediatrics (15.6%) in 2017. This trend remained consistent with hand increasing to 39.2% of graduating female residents pursuing a fellowship in the field in 2022. Sports dropped to 19.2%, and pediatrics and trauma were equal at 10.6%. The trends of female graduating residents and their

	2017	2022	P Value
Total Graduating Residents	617	726	
Total Female Graduating Residents	90	141	0.001
Total Residents Matched into Hand	151	159	
Total Female Residents Matched into Hand	24	56	0.001
Total Residents Matched into Spine	32	82	
Total Female Residents Matched into Spine	2	7	0.191
Total Residents Matched into Sports Medicine	204	223	
Total Female Residents Matched into Sports Medicine	23	27	0.931
Total Residents Matched into Trauma	42	38	
Total Female Residents Matched into Trauma	8	15	0.261
Total Residents Matched into Adult Reconstruction	94	138	
Total Female Residents Matched into Adult Reconstruction	11	12	0.869
Total Residents Matched into Oncology	18	14	
Total Female Residents Matched into Oncology	3	4	0.846
Total Residents Matched into Pediatrics	39	39	
Total Female Residents Matched into Pediatrics	14	15	0.832
Total Residents Matched into Foot & Ankle	35	33	
Total Female Residents Matched into Foot & Ankle	5	5	0.942

Fig. 1

Number of matched residents per subspecialty in 2017 vs. 2022.

preferences in fellowship selection were then contrasted with their male counterparts. The highest percentages of male graduating residents in both 2017 and 2022 entered fellowships in sports (34.1% 2017, 33.3% 2022) and hand (24.1% 2017, 17.6% 2022). The third highest percentage varied from that of their female counterparts, with adult reconstruction at 15.9% in 2017 and 21.5% in 2022 (Fig. 4). Sports and hand remain popular among both female and male residents within their sex cohorts. However, joints, although popular among male residents, only represent about 8% of female residents. In addition, pediatrics, although popular among female residents, only represents about 3% of male residents.

Geographic distribution of female graduating resident fellowship selection was also analyzed. Means of female residents in each of the NRMP geographic categories; Pacific, Mountain West North Central, West South Central, East North Central, East South Central, Middle Atlantic, South Atlantic, and New England were calculated for both 2017 and 2022. Analysis of geographic distribution showed that in all subspecialty fields except for adult reconstruction between 2017 and

2022, there was an increase in the diversity of regions represented. Adult reconstruction had 6 geographic regions represented in 2017 and 5 regions represented in 2022, with New England having the highest distribution of female residents entering adult reconstruction in 2022.

Discussion

Fellowship match trends by sex have not been analyzed previously. The purpose of this study was to understand the current subspecialty distribution of graduating female residents and the fellowship selection trends among graduating female orthopaedic surgery residents over the past 5 years. Between 2017 and 2022, the total number of female orthopaedic surgery fellows has increased from 90 (14.6%) in 2017 to 141 (19.5%) in 2022. This increase is proportionate to the increase in female orthopaedic surgery residents (14% to 19.2%) during that same period². The orthopaedic subspecialty of hand surgery has seen significant growth among female fellows in the past 5 years, whereas the distribution of female fellows among all other orthopaedic subspecialties is unchanged.

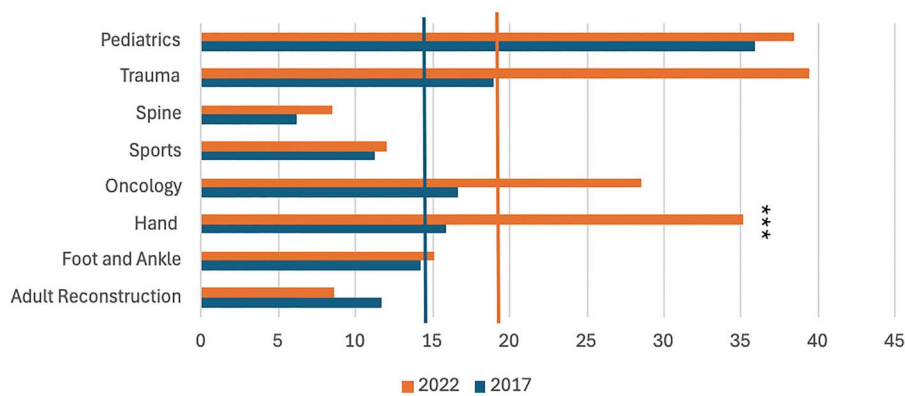


Fig. 2

Subspecialty distribution of graduating female orthopaedic residents: percentage breakdown of total residents by specialty. The percentage of female residents entering each subspecialty field out of total graduating orthopaedic residents from ACGME-accredited programs was calculated, and the data are represented below. A color-coded line for 2022 and 2017 represents the percentage of total graduating female residents from ACGME-accredited orthopaedic programs for the respective year. In 2017, 14.6% of graduating residents were female, and in 2022, 19.6% of graduating residents were female to visually represent which subspecialty fields had an equitable distribution of females entering the field. * indicates statistical significance.

Spine, sports, and adult reconstruction subspecialties continued to have the lowest distribution of female fellows over the past 5 years. In Poon et al. ten-year analysis from 2006 to 2015, female fellows preferred pediatric, hand, and oncology orthopaedic subspecialties⁷. This study found that, from 2017 to 2022, female residents have the same preferences for those 3 orthopaedic subspecialties. Moreover, this is consistent with Cannada et al. study, which demonstrated that the pediatric orthopaedic subspecialty had a higher representation of female fellows at 25% in 2016 and now stands at 39% in 2022. This distribution is especially interesting when contrasted with the distribution of male residents, where sports medicine and adult reconstruction have the highest percentages of graduating male residents matching into the subspecialties. Numerous factors have been described to influence the fellowship match decision of female residents including the importance of female mentorship within the field⁸. Demographic characteristics of divi-

sion chiefs, specifically in orthopaedic sports medicine, have been investigated. Maqsoodi et al. found that 96% of sports medicine division chiefs were men⁸. Similarly, Lavorgna et al. demonstrated that 85.6% of leadership positions among sports medicine faculty, such as program directors, were held by men⁹. The current distribution of female sports medicine fellows stands at 10.5%, the lowest of all orthopaedic subspecialties. The lack of diversity among leadership in these subspecialties may be contributing to the lack of growth in those fields among female orthopaedic surgeons resulting in perpetuation of sex disparity.

Our results identify an opportunity for improvement of sex diversity among all orthopaedic subspecialties, particularly those who have not seen growth, despite the continued increase in female fellows and residents each year. There have been several successful pipeline initiatives targeted at improving the total number of female medical students applying into orthopaedic

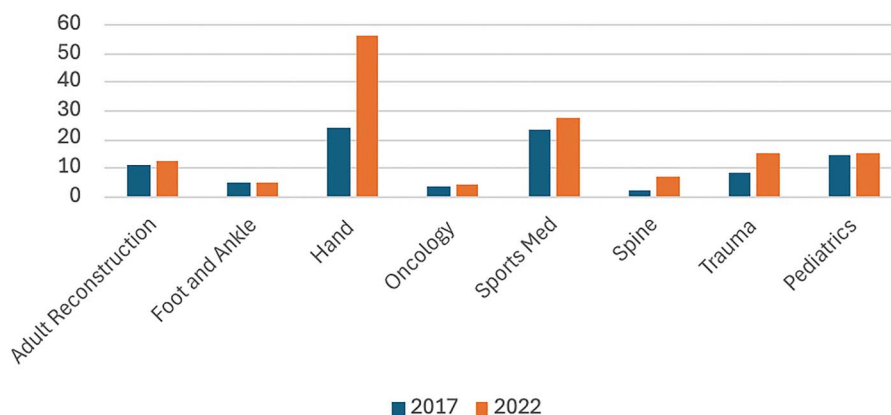


Fig. 3

Number of graduating female residents by subspecialty in 2017 vs. 2022.

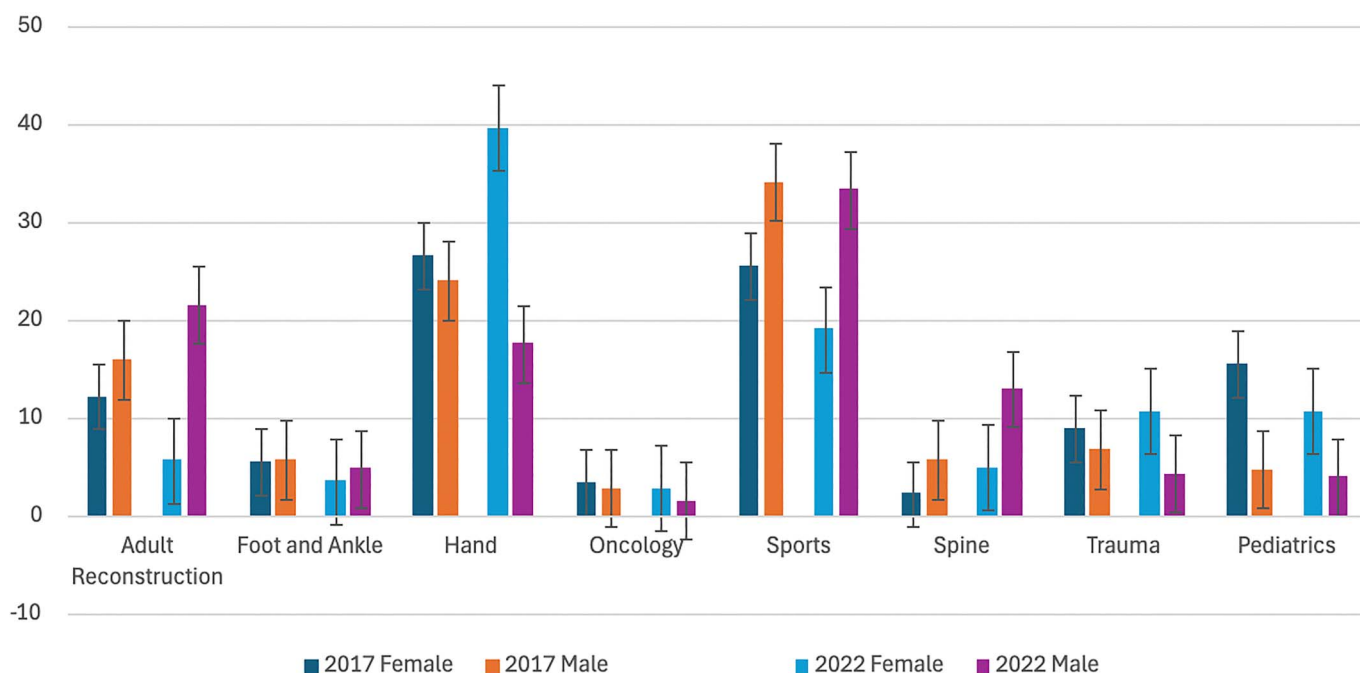


Fig. 4

Sex distribution of graduating orthopaedic residents entering each subspecialty: a comparison of 2017 and 2022.

surgery residencies. The Perry Initiative, Nth Dimensions, and the Ruth Jackson Orthopaedic Society all foster longitudinal mentorship among female high school and medical students. We suggest that creating similar initiatives, specifically targeting female orthopaedic surgery residents, may aid in recruitment efforts and bridge the sex disparity gap among certain orthopaedic subspecialties. Mentorship, by both male and female orthopaedic surgeons, has been shown to influence the rate of female medical students matching into orthopaedic surgery residency, and it is important to continue this mentorship at the fellowship level^{10,11}. Moreover, it has been shown that orthopaedic surgery residency programs with higher percentages of female faculty had higher numbers of female residents². Diversifying faculty and recruiting more female faculty into leadership positions may aid in recruitment efforts toward female residents. However, diversifying faculty is difficult when the female distribution among a subspecialty is limited, further highlighting the importance of female fellowship recruitment efforts.

There are several limitations to our study. Based on our methods, we obtained data from 75% and 81% of graduating residents in 2017 and 2022, respectively. In addition, orthopaedic surgery residents were classified as either female or male, which was determined by images and names provided by program website and pronouns when available. As such, we were limited in our ability to collect data regarding individuals who identify as nonbinary. Previous investigations were limited in analyzing the subspecialty of hand surgery and spine surgery because of its intersection with plastic surgery and other fields; however, the methods of our study allowed us to isolate orthopaedic hand fellows and orthopaedic spine fellows for analysis.

Conclusion

In conclusion, between the years 2017 and 2022, the proportion of female orthopaedic surgery fellows has increased from 14.6% to 19.5%. In addition, the subspecialty of hand surgery has seen significant growth in female fellows over the past 5 years. Other orthopaedic subspecialties including spine, trauma, adult reconstruction, oncology, pediatrics, foot and ankle, shoulder and elbow, and sports medicine have seen no significant change in the distribution of female fellows over the past 5 years. Further investigation is warranted to determine factors leading to growth in certain fellowship selections among female residents to encourage sex diversity among all subspecialty fields in orthopaedic surgery. ■

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