

# Publication Trends of Orthopaedic Residents Accepted into Spine Fellowship

Franklin J. Powlan, MD<sup>1</sup>, Benjamin R. Childs, MD<sup>2</sup>, Madison Craft, MD<sup>1</sup>, Austin B. Fares MD<sup>1</sup>, Daniel G. Kang MD<sup>3</sup>

<sup>1</sup> Texas Tech University Health Sciences Center, El Paso TX <sup>2</sup>Randolph Institute, Palm Beach FL <sup>3</sup> Madigan Army Medical Center, Tacoma WA

**Objectives:** While there is no minimum requirement of published research articles to apply for a spine fellowship, many orthopaedic surgery residents continue to publish research articles to increase their likelihood of being accepted. We hypothesize that the number of publications published by orthopaedic surgery residents accepted into a spine fellowship is increasing.

**Design:** Cross sectional study

**Main Outcome Measurements:** Data collected included the specific year of fellowship, fellowship program, region of fellowship, number of articles published, high-impact journals, and first authorship publications.

**Results:** A total of 306 spine fellows who matched between 2013 and 2019 were identified. A total of 1522 publications during residency were identified, with 404 (26.5%) publications in high-impact journals and 541 (35.5%) first-author publications. Average publications per fellow increased from 1.1 in 2013 to 6.6 in 2019, with an R<sup>2</sup> of .90 on linear regression analysis. The highest average publications came from the Midwest and South region (6.8 average publications per fellow). The Midwest region had the highest average of publications in high-impact journals (2.4 average publications per fellow) and first authorships (2.7 average publications per fellow).

**Conclusions:** The average number of publications, first authorships, and publications in high-impact journals has increased over recent years. Geographically, there is variation among programs, with fellowship programs in the Midwest having the highest average number of publications, first authorships, and publications in high-impact journals per fellow. These trends are important for residents considering applying to spine fellowship to give themselves a competitive advantage, target regions that best suit them, and provide themselves with the best opportunity to match into a spine fellowship program.

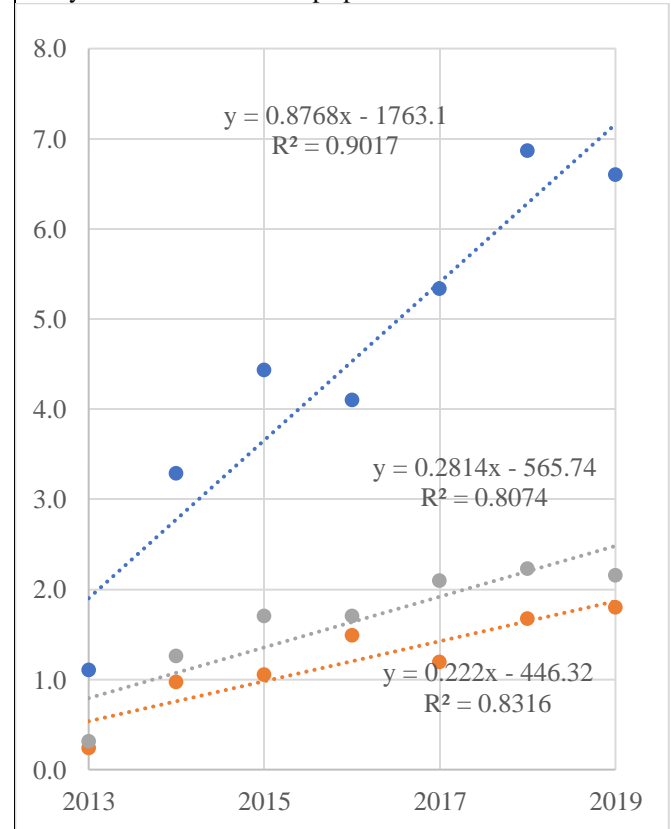
**Level of Evidence:** Level 3; Cross sectional study

**Key Words:** Orthopaedic residency; Spine; Fellowship.

## INTRODUCTION

Up to 90% of orthopaedic residency graduates complete at least one year of fellowship.<sup>1,2</sup> Fellowship training can increase career advancement, marketability, and skill mastery. Specialized training is paramount for spine surgeons as 85% of their procedures are performed within their trained specialty, and the job market demand for fellowship-trained orthopaedic surgeons continues to increase.<sup>1-3</sup>

**Figure 1:** Linear regression analysis of publications  
Blue: Mean total publications per fellow  
Orange: Mean high impact publications per fellow  
Grey: Mean first authorships per fellow



Requirements to apply for fellowship include completing the San Francisco Match Application (SF Match), graduating from orthopaedic surgery residency, submitting curriculum vitae, photograph, personal

**Table 1:** Fellow publication data by year

Fellowship Year	Fellows	Publications	Mean Publications	High Impact Publications	Mean High Impact Publications	First Author Publications	Mean First Author Publications
2019	70	462	6.6	126	1.8	151	2.2
2018	52	357	6.9	87	1.7	116	2.2
2017	42	224	5.3	50	1.2	88	2.1
2016	41	168	4.1	61	1.5	70	1.7
2015	37	164	4.4	39	1.1	63	1.7
2014	35	115	3.3	34	1.0	44	1.3
2013	29	32	1.1	7	0.2	9	0.3
Totals	306	1522	5.0	404	1.3	541	1.8

statement, and three letters of recommendation.<sup>4</sup> While there is no set requirement to for total number of publications, many applicants continue to take part in research to increase their competitive advantage to match into higher tiered fellowship programs<sup>14</sup>.

This study examines the recent research trends of accepted spine fellows during their residency. The primary outcomes were to determine the average number of publications, first authorships, and publications in high-impact journals per fellow during residency. We also determined whether the primary outcomes varied based on region. We hypothesized that the average publication rates, first authorships, and publications in high-impact journals had increased over the time period we studied, from 2013 to 2019.

## METHODS

### Data Sources

A complete list of the spine fellowship programs was obtained from the National Association of Spine Specialists (NASS). The individual programs were queried using the Google search engine (program name + spine fellowship) to get to the specific program's website. Publicly available fellow names from 2013 – 2019, typically under the 'current and past fellows' link, were located and recorded. If no fellow information was available, the fellowship's program coordinator was emailed using the email address listed in a standardized fashion to request the same information that would have

been found in the online directory (fellow's name and year of fellowship). Institutional Review Board submission was not required from the authors' institution as all the data reviewed was publicly available.

### Data Collection

The identified individuals' names were searched on PubMed, Google Scholar, and EBSCO search engines to identify all publications from that individual during their residency period; an additional year after the residency graduation year was allowed for delays in publication. Papers published before the fellow's residency were not included.

### Statistical Analysis

The following information was collected for each fellow: year of fellowship, geographic region of fellowship, number of publications, number of first authorship publications, and number of publications in high-impact journals. High-impact publications were published in Spine, The Spine Journal, Journal of Neurosurgery, and The Journal of Joint and Bone Surgery. In total, 306 fellows were identified from 2013 to 2019. Geographic regions were the same as previously reported work<sup>14</sup>. Data was analyzed in Microsoft Excel.

**Table 2:** Fellow publications by region

2013 to 2019	Fellows	Publications	Mean Publications	High Impact Publications	Mean High Impact Publications	First Author Publications	Mean First Author Publications
Midwest	56	382	6.8	134	2.4	149	2.7
Northeast	41	160	3.9	45	1.1	41	1.0
South	82	560	6.8	125	1.5	209	2.5
West	127	420	3.3	100	0.8	142	1.1

## RESULTS

Of the 71 ACGME-accredited spine fellowship programs at the time of this publication, information on past fellows was gathered from 46 programs (64.8%). From 2013 to 2019, 306 fellows were identified who published 1522 articles, with an average of 5.0 articles per fellow (Table 1). There were 541 first authorships and 406 publications in high-impact journals for an average of 1.8 and 1.3 publications per fellow, respectively. (Table 1) Overall, there was an increasing trend in the average number of publications, the average number of first authorships, and the average number of publications in high-impact journals. Linear regression of average publications, first authorships, and high-impact journal publications over the study period had R2 values of .90, .81, and .83. (Figure 1)

The Midwest and South programs had the highest average number of publications at 6.8 per fellow, while the Northeast and West had 3.8 and 3.3 publications per fellow, respectively. (Table 2) Programs in the Midwest also had the highest average first authorships (2.7 per fellow) and publications in high-impact journals (2.4 per fellow). (Table 2)

## DISCUSSION

The absolute number of publications and the average number of publications per spine fellow have increased over recent years, paired with an increase of higher quality research as signified by a gradual increase in the average number of publications in high-impact

journals. There are many reasons for an increase in the average number of publications per fellow, including increased protected research time,<sup>6,7</sup> characteristics of programs and residents,<sup>8,9</sup> and recent duty hour restrictions.<sup>10,11</sup> While the interview, letters of recommendation, and familiarity with the letter writers or applicants are among the top factors in program directors selecting fellows, research experiences consistently rank in the top 5 important selection factors.<sup>2,5,12,13</sup> It is the only objective measurement that applicants can directly change while in residency, and it is consistently ranked as an important factor when program directors select fellows.<sup>2,12,13</sup>

Grabowski et al. surveyed program directors of all orthopaedic subspecialties and found that before interview offers being sent, publications and presentations ranked fourth in importance behind letters of recommendation from subspecialty-specific staff, quality of residency program, and letters of recommendation from residency program directors.<sup>2</sup> After the interview, however, among all specialties, the most important factors became the interview, letters of recommendation from subspecialty-specific staff, and letters of recommendation from residency program directors, with publications and presentations falling fifth. For spine fellowship specifically, Graboski et al. found that program directors ranked publications and presentations third, with only letters of recommendation from subspecialty-specific staff and quality of residency program ahead of it.<sup>2</sup> Letters of recommendation from

residency program directors did not rank in the top 3 factors of importance. After the interview, though, the interview, letters of recommendation, subspecialty-specific staff, and expressing interest in the program were the most important factors to spine fellowship program directors.<sup>2</sup>

While residents cannot control the perceived quality of their residency program, research experiences offer additional opportunities to work with, network, and obtain letters of recommendation from more impactful faculty and staff in the specific field of interest. These research experiences can significantly aid fellowship applicants as they will have a broader network to assist in making themselves more familiar to faculty and program directors. This is especially pertinent for residents from smaller programs who may only have one fellowship-trained spine surgeon with a limited network. Research experiences also allow residents from 'lower quality' programs to show that they are subjectively and objectively equivalent to residents from 'higher quality' programs in at least one facet, giving more control to the fellowship applicant to make themselves a more competitive applicant.

The Midwest and South regions had the highest average amount of publications per fellow at 6.8. The Midwest also had the highest first authorships (2.7 per fellow) and publications in high-impact journals (2.4 per fellow). The West region had the lowest average of publications per fellow (3.3 per fellow) and lowest publications in high-impact journals (0.8 per fellow), with the most fellows located in the West region (41.5%). The lower publication averages found in the western region are likely due to multiple factors, including the number of programs, the perceived quality of programs, and the program directors' focus when selecting fellows.

This study had multiple limitations, most notably, a failure to capture all potential fellows. Only 64.8% of

the programs were able to be captured in the most recent year, with decreased information from prior years.

Information provided on program websites could have been more extensive and consistent. This greatly affected our sample size, with only 42 of 124 (33.9%) fellows being captured in 2017. The SF Match application is typically submitted during the 4th year of residency as most residents start fellowship immediately after graduating residency. Thus, articles published afterward are less likely to have an impact. However, the SF Match application does include a section for ongoing research activities typically used for ongoing projects that may be published soon. We attempted to capture all publications during residency by including any publication one year after graduation. However, this could have over-inflated our results with publications submitted during the beginning of the fellowship. Despite these limitations, this study provides valuable information that gives insight into current research trends that can help future spine fellowship applicants, residency programs, and program directors make more informed decisions.

## CONCLUSION

The average number of publications, first authorships, and publications in high-impact journals has increased over recent years. Geographically, there is variation among programs, with fellowship programs in the Midwest having the highest average number of publications, first authorships, and publications in high-impact journals per fellow. In contrast, those in the West had the lowest average number of publications and publications in high-impact journals per fellow. These trends are important for residents considering applying to spine fellowships to give themselves a competitive advantage, target regions that best suit them, and provide the best opportunity to be matched into a spine fellowship program.

## REFERENCES

1. Horst PK, Choo K, Bharucha N, Vail TP. Graduates of Orthopaedic Residency Training Are Increasingly Subspecialized: A Review of the American Board of Orthopaedic Surgery Part II Database. *J Bone Joint Surg Am.* 2015;97(10):869-875. doi:10.2106/JBJS.N.00995
2. Grabowski G, Walker JW. Orthopaedic fellowship selection criteria: a survey of fellowship directors. *J Bone Joint Surg Am.* 2013;95(20):e154. doi:10.2106/JBJS.L.00954
3. Morrell NT, Mercer DM, Moneim MS. Trends in the orthopedic job market and the importance of fellowship subspecialty training. *Orthopedics.* 2012;35(4):e555-e560. doi:10.3928/01477447-20120327-13
4. DeFroda SF, Shah KN, Safdar O, et al. Trends in research productivity of residents applying for orthopedic sports medicine fellowship. *Phys Sportsmed.* 2018;46(1):61-65. doi:10.1080/00913847.2018.1411170
5. Bernatz, James T. MDa, Johnson, Kristina P. MPA, ATCa, Stokman, James J. MDa, et al. Factors Considered in Ranking Spine Surgery Fellowship Applicants, SPINE: July 1, 2021 - Volume 46 - Issue 13 - p 882-885 doi: 10.1097/BRS.0000000000003938
6. Krueger CA, Hoffman JD, Balazs GC, et al. Protected Resident Research Time Does Not Increase the Quantity or Quality of Residency Program Research Publications: A Comparison of 3 Orthopaedic Residencies. *J Surg Educ.* 2017;74(2):264-270 doi: 10.1016/j.jsurg.2016.08.008.
7. Williams BR, Agel JA, Van Heest AE. Protected Time for Research During Orthopaedic Residency Correlates with an Increased Number of Resident Publications. *J Bone Joint Surg Am.* 2017;99(13):e73 doi: 10.2106/jbjs.16.00983
8. Osborn PM, Ames SE, Turner NS, et al. An Analysis of Research Quality and Productivity at Six Academic Orthopaedic Residencies. *J Surg Educ.* 2018;75(6):1635-1642 doi: 10.1016/j.jsurg.2018.04.022.
9. Kurian EB, Desai VS, Turner NS, et al. Is Grit the New Fit?- Assessing Non-Cognitive Variables in Orthopaedic Surgery Trainees. *J Surg Educ.* 2019;76(4):924-930 doi: 10.1016/j.jsurg.2019.01.010.
10. Johnson JP, Savage K, Gil JA, et al. Increased Academic Productivity of Orthopaedic Surgery Residents Following 2011 Duty Hour Reform. *J Surg Educ.* 2018;75(4):884-887 doi: 10.1016/j.jsurg.2017.12.001.
11. Levy DM, Luchetti TJ, Levine BR. Have Residents Produced More Research Since the Inception of the 80-Hour Workweek? *Iowa Orthop J.* 2017;37:205-209
12. Nies MS, Bollinger AJ, Cassidy C, et al. Factors used by program directors to select hand surgery fellows. *J Hand Surg Am.* 2014;39(11):2285-2288.e2285 doi: 10.1016/j.jhsa.2014.07.012.
13. Baweja R, Kraeutler MJ, Mulcahey MK, et al. Determining the Most Important Factors Involved in Ranking Orthopaedic Sports Medicine Fellowship Applicants. *Orthop J Sports Med.* 2017;5(11):2325967117736726 doi: 10.1177/2325967117736726.
14. DeFroda SF, Shah KN, Safdar O, et al. Trends in Research Productivity of Residents Applying for Orthopedic Sport Medicine Fellowship. *Phys Sports Med.* 2018;46(1):61-65. doi: 10.1080/00913847.2018.1411170