

Outcomes in the Orthopaedic Sports Medicine Fellowship Match, 2010-2017

Mary K. Mulcahey,^{*†} MD, Meghan K. Hayes,[‡] BS, Christopher M. Smith,[§] MD, Matthew J. Kraeutler,^{||} MD, Jeffrey D. Trojan,[†] BA, and Eric C. McCarty,[¶] MD

Investigation performed at Tulane University School of Medicine, New Orleans, Louisiana, USA

Background: Sports medicine is one of the most competitive fellowships in orthopaedic surgery. Despite its popularity, fellowship applicants have limited understanding of the orthopaedic sports medicine fellowship match process.

Purpose: To define key outcomes in the orthopaedic sports medicine fellowship match, including the overall match rate, number of programs filled, and number of applicants ranked by programs that filled between 2010 and 2017.

Study Design: Cross-sectional study.

Methods: This study utilized data regarding the orthopaedic sports medicine fellowship match collected by the American Orthopaedic Society for Sports Medicine (AOSSM) from 2010 through 2017. Applicant data included number of applicants, number of matched and unmatched applicants, and percentage of applicants matching into their top choices. Fellowship program data included number of programs participating in the match and number of applicants ranked by filled and unfilled programs.

Results: Between 2010 and 2017, the mean number of orthopaedic sports medicine fellowship applicants was 244.8. On average, 92.0% of applicants matched into a fellowship program. The mean number of programs participating in the fellowship match was 92.9, with a mean of 219.9 accredited positions and 5.4 nonaccredited positions. Over the time period studied, a mean of 75.8% of programs matched all available positions. Programs that matched fully ranked 9.0 applicants per position, on average, compared with a mean of 6.5 applicants ranked per position among programs that did not fully match ($P = .0016$).

Conclusion: From 2010 to 2017, the number of applicants, positions available, overall match rate, and number of programs participating in the orthopaedic sports medicine fellowship match have remained consistent. The mean number of applicants per position ranked by fully matched fellowship programs was 9.0 compared with a mean of 6.5 applicants per position ranked by programs that did not fully match. These data may be helpful as we look to the future of orthopaedic sports medicine fellowship positions and the match process. In addition, this study reveals characteristics that divide sports medicine fellowship programs that fully match from those that do not. Applicants and/or fellowship program directors may utilize this information to modify their approach to the match process going forward.

Keywords: orthopaedic surgery; sports medicine; fellowship match; fellowship education

Orthopaedic surgery is becoming increasingly specialized. Recent studies have demonstrated that approximately 90% of orthopaedic residents pursue fellowship training after graduation,^{5,6,12} which is a substantial increase from 76% in 2003.⁶ The development of orthopaedic subspecialty societies began in the 1970s and has increased significantly over the past several decades. There are many reasons proposed for the rise in specialization, including the desire to be responsible for a more manageable body of knowledge, to improve clinical expertise, and to pursue academic goals.^{8,9,13-15} Heightened subspecialization coincides with a decrease in the proportion of practicing orthopaedic generalists from 44% to 29% between 1990 and 2006.¹¹

Additionally, the percentage of job postings specifically seeking fellowship-trained orthopaedic surgeons increased from 16.7% to 68.2% between 1984 and 2009.⁹

Together with an increase in the number of applicants for orthopaedic fellowships, the process of applying to fellowship programs has evolved over the past several years. Currently, the majority of orthopaedic fellowship programs utilize a centralized, formal matching process.² Sports medicine fellowship programs utilized the National Resident Matching Program until 2005.² After the discontinuation of the formal matching process, residents were often asked to commit to a position during their third year of residency, before receiving adequate exposure to all subspecialties, or they were forced to accept or reject an offer before they could compare programs.¹⁰

A survey conducted at the 2007 American Orthopaedic Association (AOA) Symposium on Fellowships found that

The Orthopaedic Journal of Sports Medicine, 6(5), 2325967118771845
DOI: 10.1177/2325967118771845
© The Author(s) 2018

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For reprints and permission queries, please visit SAGE's website at <http://www.sagepub.com/journalsPermissions.nav>.

79% of attendees believed the then-current application process was unacceptable, and 87% of those polled felt that the process was specifically unfair to residents.^{2,5} That same year, the American Academy of Orthopaedic Surgeons (AAOS) formed a subcommittee known as the Board of Specialty Societies Fellowship Match Oversight Committee to provide direction to orthopaedic fellowship programs to ensure a fair match process for both the applicants and the fellowship programs. The sports medicine fellowship programs rejoined the formal match in 2008, utilizing the San Francisco Match.

A recent study assessed the match process and the Accreditation Council for Graduate Medical Education (ACGME) status of fellowships in the 9 orthopaedic subspecialties (adult reconstructive orthopaedics, foot and ankle orthopaedics, hand surgery, musculoskeletal oncology, orthopaedic sports medicine, orthopaedic surgery of the spine, orthopaedic trauma, pediatric orthopaedics, and shoulder and elbow surgery).³ This study discovered that 25% of available orthopaedic fellowship positions are devoted to sports medicine.^{3,12} Sports medicine is also the most popular orthopaedic subspecialty among current AAOS members, with the percentage of members who completed a sports medicine fellowship rising from 27% in 2004 to 49% in 2010.¹⁶ Additionally, orthopaedic sports medicine was found to have the highest proportion of ACGME-accredited fellowship programs, with 93.1% of programs and 97.3% of positions receiving accreditation.³

Despite the popularity of orthopaedic sports medicine, fellowship applicants have little understanding of important trends in the match process.^{1,4} The purpose of this study was to define key outcomes in the orthopaedic sports medicine fellowship match, including the overall match rate, number of programs filled, and number of applicants, ranked by programs that filled between 2010 and 2017. The study analyzed the match data made available by the American Orthopaedic Society for Sports Medicine (AOSSM).

METHODS

The AOSSM collects data annually about the orthopaedic sports medicine fellowship match and shares the information with fellowship directors. Permission was obtained from the AOSSM to utilize the data for study purposes. An 8-year period from 2010 to 2017 was analyzed, including match data from all years available. Information was collected in 2 broad categories (applicant participation and

TABLE 1
Categories of Data Analyzed in the Orthopaedic Sports Medicine Fellowship Match

Category
<i>Applicant participation</i>
Number of applicants registered for the match
Number of applicants who withdrew or did not submit a rank list
Number of applicants who submitted a rank list
Percentage of applicants who matched to their #1-ranked program
Percentage of applicants who matched to their #2-ranked program
Percentage of applicants who matched to their #1- or #2-ranked program
<i>Program participation</i>
Number of programs participating in the match
Number of positions in the match
Percentage of positions that matched
Percentage of programs that fully matched
Mean number of applicants ranked per position for programs that fully matched
Mean number of applicants ranked per position for programs that did not fully match
Percentage of programs that matched their #1-ranked applicant
Percentage of programs that matched their #2-ranked applicant

program participation), each of which included numerous subcategories (Table 1). Standard descriptive statistics were used to analyze the data.

RESULTS

Applicant Participation

The number of applicants registering for the orthopaedic sports medicine fellowship match ranged from 202 in 2014 to 275 in 2013 (mean \pm SD, 244.8 \pm 22.2 applicants per year). In 2012, only 28 applicants withdrew from the match, while in 2015, 47 applicants withdrew (Figure 1). The percentage of matched applicants was as low as 84.8% in 2013 and as high as 96.8% in 2016 (mean \pm SD, 92.0% \pm 4.1%). The mean percentage of unmatched applicants between 2010 and 2017 was 7.9% \pm 4.1% (range, 3.2%-15.2%). The mean percentage of applicants matching into their #1-ranked program was 49.3% \pm 4.6% (range, 42.4%-56.2%), while the mean percentage matching into their #1- or #2-ranked program was 67.7% \pm 4.6% (range, 61.8%-77.0%) (Table 2).

*Address correspondence to Mary K. Mulcahey, MD, Department of Orthopaedics, Tulane University School of Medicine, 1430 Tulane Avenue, #8632, New Orleans, LA 70118, USA (email: mary.mulcahey.md@gmail.com).

[†]Department of Orthopaedics, Tulane University School of Medicine, New Orleans, Louisiana, USA.

[‡]Drexel University College of Medicine, Philadelphia, Pennsylvania, USA.

[§]Department of Emergency Medicine, Cooper Medical School of Rowan University, Camden, New Jersey, USA.

^{||}Department of Orthopaedic Surgery, Seton Hall–Hackensack Meridian School of Medicine, South Orange, New Jersey, USA.

[¶]Department of Orthopedics, University of Colorado School of Medicine, Aurora, Colorado, USA.

One or more of the authors has declared the following potential conflict of interest or source of funding: M.K.M. receives educational support from Arthrex, Tornier, and Zimmer Biomet. E.C.M. receives royalties from Zimmer Biomet and Elsevier, is a paid consultant for Zimmer Biomet, and receives research support from Zimmer Biomet, Mitek, Smith & Nephew, and Stryker.

Ethical approval was not sought for the present study.

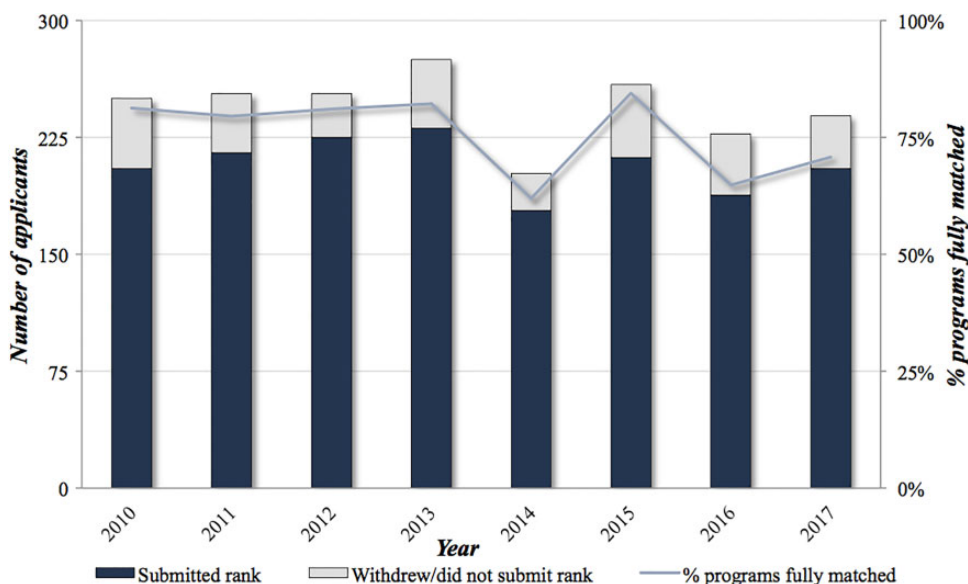


Figure 1. Correlation of applicants who submitted or withdrew their rank list and the percentage of fully matched sports fellowship programs.

TABLE 2
Data for Applicants Participating in the Orthopaedic Sports Medicine Fellowship Match

Applicant Participation	Match Year, n								Mean ± SD
	2010	2011	2012	2013	2014	2015	2016	2017	
Registered for match	250	253	253	275	202	259	227	239	244.8 ± 22.2
Submitted rank list	205	215	225	231	178	212	188	205	207.4 ± 17.7
Matched applicants	187	196	198	196	169	202	182	193	190.4 ± 10.7
Matched #1 rank	101	107	104	98	100	96	101	106	101.6 ± 3.8
Matched #2 rank	37	35	35	49	37	48	27	38	38.3 ± 7.2
Matched top 5 ranks	—	—	—	—	169	191	177	186	180.8 ± 9.7
Unmatched applicants	18	19	27	35	9	10	6	12	7.9 ± 4.1

Program Participation

The number of programs participating in the orthopaedic sports medicine fellowship match ranged from 89 in 2017 to 97 in 2012 (mean ± SD, 92.9 ± 2.9). The mean number of programs submitting a rank list between 2010 and 2017 was 91.4 ± 1.9 (range, 89-95). The total number of accredited positions available in the match ranged from 213 in 2010 to 224 in both 2016 and 2017 (mean ± SD, 219.9 ± 3.6). The mean number of nonaccredited positions was 5.4 ± 3.3 (range, 3-13). The mean percentage of fully matched programs over the 8-year period was 75.8% ± 8.7% (range, 62.0%-84.4%). The percentage of programs that matched their #1-ranked applicant ranged from 12.0% in 2014 to 27.4% in 2012 (mean ± SD, 20.2% ± 4.6%). The mean percentage of programs that matched either their #1- or #2-ranked applicant was 34.9% ± 7.8% (range, 25.0%-49.5%) (Table 3). The mean number of applicants ranked per position among programs that

matched all available positions was 9.0 ± 0.7 (range, 7.9-10.1) compared with a mean of 6.5 ± 1.3 applicants per position ranked (range, 4.4-7.8) among programs that did not fully match (*P* = .0016) (Figure 2).

DISCUSSION

This study utilized data from the AOSSM to examine trends in the orthopaedic sports medicine fellowship match between 2010 and 2017. During this 8-year period, there has been little variation regarding the number of applicants, overall match rate, number of programs filled, or number of applicants ranked by fellowship programs. Interestingly, this analysis demonstrated that there is a statistically significant difference between the mean number of applicants ranked per position by programs that filled and those that did not fill (9.0 vs 6.5, respectively; *P* = .0016).

TABLE 3
Data for Programs Participating in the Orthopaedic Sports Medicine Fellowship Match

Program Participation	Match Year, n								Mean \pm SD
	2010	2011	2012	2013	2014	2015	2016	2017	
Programs in match	93	96	97	91	95	91	91	89	92.9 \pm 2.9
Programs fully matched	74	74	77	74	57	76	59	63	69.3 \pm 8.2
Matched #1 rank	19	21	26	21	11	18	15	17	18.5 \pm 4.5
Matched #2 rank	26	13	12	13	12	10	11	10	13.4 \pm 5.2
Matched top 5 ranks	—	—	—	—	22	27	18	15	20.5 \pm 5.2
Positions in match	226	220	224	224	226	226	227	229	225.3 \pm 2.7
Accredited positions	213	217	221	220	220	220	224	224	219.9 \pm 3.6
Nonaccredited positions	13	3	3	4	6	6	3	5	5.4 \pm 3.3
Positions filled	187	196	198	196	169	202	182	193	190.4 \pm 10.7
Positions unfilled	39	24	26	28	57	24	45	36	34.9 \pm 11.8

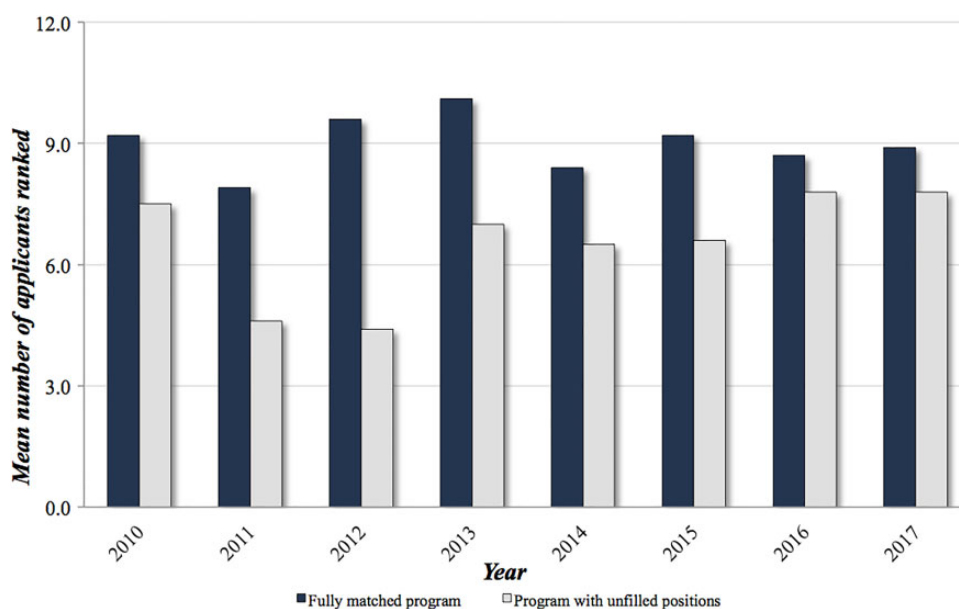


Figure 2. Mean number of applicants ranked among fully matched programs compared with those with unfilled positions.

The mean number of applicants for orthopaedic sports medicine fellowships remained consistent at 244.8 over the 8-year period. Although not statistically significant, there were 3 years in which the number of applicants and percentage of filled fellowship programs were lower than average. In 2014, 2016, and 2017, the number of applicants was 202, 227, and 239, respectively. Although it is unclear from these data alone why the numbers decreased for those years, the fewest number of applicants applied in 2014 after 15% of applicants who submitted a rank list went unmatched in 2013.

The mean number of programs participating in the orthopaedic sports medicine fellowship match during the study period was 92.9 ± 2.9 (range, 89-97), with a mean of 219.9 ± 3.6 accredited positions offered (range, 213-224). Although not statistically significant, the number of fellowship programs in the match decreased from 95 in 2014 to 91 in 2015 and 89 in 2017. Although it is unclear from

the data alone, this continued decrease in the number of fellowship programs participating in the match could be a potential consequence of unmatched fellowship positions. However, the number of positions offered in the match remained stable throughout the 8-year span. Sports medicine consistently has the highest number of fellowship positions available within orthopaedic surgery, followed by hand surgery with 168 positions. Shoulder and elbow surgery, on the other hand, has the fewest number of fellowship positions at 42.³

A 2014 study by Daniels et al³ investigated orthopaedic subspecialty fellowships in terms of the match process, characteristics, and ACGME accreditation. Fellowships were assessed by searching subspecialty society webpages and individual program websites. This study found that among the 9 orthopaedic subspecialty fellowships, there were collectively more positions offered than there were graduating orthopaedic residents.³ In 2013, there were

792 allopathic and osteopathic resident graduates and 897 total fellowship positions.³ The current study demonstrates that the opposite trend exists for applicants to sports medicine fellowships. In each year, excluding 2014, there were more sports medicine fellowship applicants than positions available.

A similar study in 2015 evaluated the match process for all orthopaedic subspecialties and found that the percentage of applicants who matched into their first choice of fellowship between 2010 and 2013 varied greatly between specialty and even between years in each specialty.² During this time, the most variable number of applicants matching into their first-choice fellowship was in the specialties of spine (range, 19%-68%) and foot and ankle (range, 31%-62%).² The current study demonstrates that sports medicine has remained consistent during the 8-year period analyzed, with a mean of 49.3% \pm 4.6% of applicants (range, 42.4%-56.2%) matching into their #1-ranked program.

This study shows that during the 8-year period analyzed, the match process has favored the applicant, with 67.7% of applicants having matched into their #1- or #2-ranked programs, while only 34.9% of programs matched their #1- or #2-ranked applicant. A mean of 7.9 applicants went unmatched each year.

Match rates for applicants and programs did not vary significantly during the 8-year study period. The mean percentage of fully matched programs was 75.8%. Programs that ranked more applicants were significantly more likely to fully match. Fellowships that fully matched ranked a mean of 9.0 applicants per position (range, 7.9-10.1) compared with 6.5 applicants ranked (range, 4.4-7.8) per position by programs that did not fully match ($P = .0016$). A similar study investigated the expectations, logistics, and costs relevant to the hand surgery fellowship application process.⁷ Utilizing an online survey of fellowship applicants and program directors of the 81 ACGME-accredited hand surgery fellowship programs during the 2015 application cycle, the authors found that 34% of programs ranked 1-10 applicants, 36% ranked 11-20 applicants, and the remaining 40% ranked ≥ 21 applicants.⁷ This suggests that hand surgery fellowship programs rank more applicants than do sports medicine fellowship programs. In addition to ranking more applicants, hand fellowships also had a higher percentage of positions filled than sports medicine programs: 96% versus 88%, respectively (match results from 2013).²

There are several limitations to this study. First, this was a retrospective study evaluating data collected annually by the AOSSM between 2010 and 2017. It was designed to analyze trends in the orthopaedic sports medicine fellowship match over several years. However, the data collection did not include information that would help explain the variation between match cycles. Additionally, these data do not speak to the characteristics of applicants or fellowship programs themselves. The AOSSM data did not include information on the mean number of interviews attended by each applicant. Finally, the AOSSM data are purely descriptive and did not allow for commentary from either applicants or programs about the match process.

CONCLUSION

From 2010 to 2017, the number of applicants, positions available, overall match rate, and number of programs participating in the orthopaedic sports medicine fellowship match have remained consistent. These data may be helpful as we look to the future of orthopaedic sports medicine fellowship positions and the match process. In addition, this study reveals characteristics that separate sports medicine fellowship programs that fully match from those that do not. Applicants and/or fellowship program directors may utilize this information to alter their approach to the match process going forward.

REFERENCES

1. Baweja R, Kraeutler MJ, Mulcahey MK. The most important factors involved in ranking orthopaedic sports medicine fellowship applicants. *Orthop J Sports Med.* 2017;5(11):2325967117736726.
2. Cannada LK, Luhmann SJ, Hu SS, Quinn RH. The fellowship match process: the history and a report of the current experience. *J Bone Joint Surg Am.* 2015;97(1):e3.
3. Daniels AH, Grabel Z, DiGiovanni CW. ACGME accreditation of orthopaedic surgery subspecialty fellowship training programs. *J Bone Joint Surg Am.* 2014;96(11):e94.
4. Haislup BD, Kraeutler MJ, Mulcahey MK, McCarty EC. Orthopaedic sports medicine fellowship interviews: structure and organization of the interview day. *Orthop J Sports Med.* 2017;5(12):2325967117741276.
5. Harner CD, Ranawat AS, Niederle M, et al. AOA Symposium. Current state of fellowship hiring: is a universal match necessary? Is it possible? *J Bone Joint Surg Am.* 2008;90(6):1375-1384.
6. 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.
7. Meals C, Osterman M. The hand surgery fellowship application process: expectations, logistics, and costs. *J Hand Surg Am.* 2015;40(4):783-789.
8. Mir HR, Cannada LK, Murray JN, Black KP, Wolf JM. Orthopaedic resident and program director opinions of resident duty hours: a national survey. *J Bone Joint Surg Am.* 2011;93(23):e1421-e1429.
9. 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.
10. Niesen MC, Wong J, Ebramzadeh E, et al. Orthopedic surgery fellowships: the effects of interviewing and how residents establish a rank list. *Orthopedics.* 2015;38(3):175-179.
11. Oladeji LO, Pehler SF, Raley JA, Khoury JG, Ponce BA. Is the orthopedic fellowship interview process broken? A survey of program directors and residents. *Am J Orthop.* 2015;44(11):e444-e453.
12. Salsberg ES, Grover A, Simon MA, Frick SL, Kuremsky MA, Goodman DC. An AOA Critical Issue. Future physician workforce requirements: implications for orthopaedic surgery education. *J Bone Joint Surg Am.* 2008;90(5):1143-1159.
13. Sarmiento A. Additional thoughts on orthopedic residency and fellowships. *Orthopedics.* 2010;33:712-713.
14. Sarmiento A. Subspecialization in orthopaedics: has it been all for the better? *J Bone Joint Surg Am.* 2003;85(2):369-373.
15. Simon MA, Cooper RR, Urbaniak JR, Bergfeld JA. Symposium. Orthopaedic surgery fellowships: a ten-year assessment. *J Bone Joint Surg Am.* 1998;80(12):1826-1850.
16. Yin B, Gandhi J, Limpisvasti O, Mohr K, ElAttrache NS. Impact of fellowship training on clinical practice of orthopaedic sports medicine. *J Bone Joint Surg Am.* 2015;97(5):e27.