THE ORTHOPAEDIC FORUM

Early-Career Sports Medicine Surgeons Perform a Large Volume of Non-Sports Medicine Procedures

American Board of Orthopaedic Surgery (ABOS) Part-II Data Regarding Orthopaedic Surgeons Specializing in Sports Medicine

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Background: The purpose of this study was to utilize the American Board of Orthopaedic Surgery (ABOS) Part-II Case List database to (1) define the practice patterns of sports medicine-trained ABOS Part- II Oral Examination Candidates and (2) describe the frequency and practice patterns of individuals who are dual fellowship-trained sports medicine candidates.

Methods: The ABOS Part-II Case List database was utilized to define all cases submitted by 3,298 applicants indicating completion of a sports medicine fellowship between January 1, 2003, and January 1, 2020. Cases were classified by subspecialty category and case type. The frequency and practice patterns of candidates pursuing additional fellowship training (i.e., "dual fellowship-trained") were recorded. Descriptive statistical methods were used to describe the annual and overall procedure volume and candidate case mix. Trends in the relative frequency of cases performed and fellowship training patterns were determined using linear regression analysis.

Results: On average, sports medicine-trained candidates submitted 100.6 cases for review during the 6-month case collection period: 59.0 (58.6%) sports medicine/arthroscopy cases, 29.3 (29.1%) trauma/general cases, 4.5 (4.5%) adult reconstruction cases, and 7.8 (7.8%) "other" cases per candidate. Although candidates performed fewer total ($r^2 = 0.84$, $p < 0.001$) and sports medicine/arthroscopy ($r^2 = 0.85$, $p < 0.001$) cases over the study period, the proportion of sports medicine/arthroscopy cases did not change over the study period ($p = 0.18$). Dual fellowship training was indicated by 333 individuals (10.1%). The number of dual fellowship-trained candidates pursuing additional fellowship training in pediatrics and adult reconstruction increased over the study period, and the number of dual fellowship-trained candidates pursuing additional fellowship training in trauma decreased over the study period.

Conclusions: Early-career sports medicine candidates are likely to perform >40% of cases outside of the sports medicine subspecialty. Sports medicine trainees are increasingly likely to pursue a second fellowship in pediatrics or adult reconstruction.

Level of Evidence: Therapeutic Level III. See Instructions for Authors for a complete description of levels of evidence.

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More than 90% of graduating orthopaedic surgery residents will pursue fellowship training[1,2], and trainees are increasingly likely to pursue multiple fellowship opportunities[3,4]. While the primary motivations for pursuing additional training are highly variable (e.g., intellectual stimulation, a desirable variety of cases, financial goals[5], or interactions with a strong mentor[6]), fellowship training may also serve to improve a young surgeon's opportunities in the workforce. Specifically, in 70% of employment opportunities, the employer seeks a fellowship-trained orthopaedic surgeon, and employers are increasingly likely to prefer those with subspecialty training[1].

Despite the benefits of orthopaedic fellowship training, complexities arise as fellowship-trained surgeons enter the workforce and rapidly increase the supply of orthopaedic surgeons who are able to perform subspecialty-specific procedures. For example, young surgeons in the subspecialty of orthopaedic oncology perform >50% of all cases outside of their chosen subspecialty[7] and perform substantially fewer oncologic cases than their older colleagues[8]. These findings illustrate the potential for market disequilibrium within certain subspecialties of orthopaedic surgery as well as the trend toward a greater focus within a subspecialty as a career and practice matures.

The subspecialty of orthopaedic sports medicine—the largest subspecialty in orthopaedics[9]—is likely to share some characteristics with the overall orthopaedic workforce. Additionally, the changing landscape of a sports medicine practice with the expansion of subspecialty areas such as hip arthroscopy[5] and pediatric sports medicine[6] may uniquely impact the practice patterns of recent sports medicine graduates. Given both the general evolution of the orthopaedic employment market and the unique advances in orthopaedic sports medicine, defining the practice patterns of recent orthopaedic sports medicine trainees provides useful information for current trainees, advisers, fellowship program directors, and practice groups.

The American Board of Orthopaedic Surgery (ABOS) Part-II Oral Examination Case List collection period, which occurs after at least 5 months of practice at a single institution, has been previously leveraged to describe both the subspecialization and practice patterns of recent fellowship graduates[3,4,7,10]. The purpose of this study was to utilize the ABOS Part-II Case List database to (1) define the practice patterns of sports medicine-trained ABOS Part-II Oral Examination candidates and (2) describe the frequency and practice patterns of individuals who are dual fellowship-trained sports medicine candidates.

Materials and Methods

Data Source

The ABOS Part-II Oral Examination Case List database was utilized to define all of the cases submitted by candidates who indicated completion of a sports medicine fellowship between January 1, 2003, and January 1, 2020. Importantly, although this cohort included individuals undergoing the certification process during the early COVID-19 pandemic (i.e., March 2020), their corresponding case lists were collected and submitted prior to January 1, 2020. The demographics and data collection utilized in this database have been discussed at length in prior publications[10,11]. Briefly, this database comprises all cases recorded over a 6-month period by applicants for ABOS Board Certification and is deidentified following a candidate's completion of the certification process. Information collected for each procedure includes the International Classification of Diseases (ICD) and Current Procedural Terminology (CPT) codes that are associated with the procedure, the date the procedure was performed, the anatomic location of the surgery, any complications associated with the procedure, and the type of fellowship training of the surgeon performing the procedure. Procedural data are submitted by the ABOS candidate through an online platform, and the data are maintained and stored by the organization. After review by the ABOS Research Committee, the data were accessed by the study team through a research agreement.

Data Analysis

In the ABOS database, CPT codes may be tracked for a given procedure; thus, the analysis was performed for unique procedures rather than discrete surgeries. The frequency of each case performed each year was tabulated among candidates identifying as having completed a sports medicine fellowship. Individuals pursuing multiple fellowships (i.e., "dual fellowship-trained") were analyzed separately since this study sought to understand the practice pattern of the typical fellowship-trained sports medicine surgeon. The alterations in case mix for dual fellowship-trained candidates could have been due to a multitude of factors, such as their preferred subspecialty, unique call obligations or capabilities related to a second fellowship, or a niche practice focus, and therefore could limit the generalizability of these results to all sports medicine surgeons.

To assist in the interpretation of case logs, CPT codes for all orthopaedic surgery procedures tracked by the Accreditation Council for Graduate Medical Education (ACGME) were sorted by subspecialty (i.e., sports medicine/arthroscopy, trauma/general, adult reconstruction, and "other") (see Appendix Supplemental Table 1). When a case could reasonably be categorized under multiple subspecialties (e.g., CPT Code 23515: ORIF [open reduction and internal fixation] Clavicle Fracture), we defaulted to classifying the procedure as falling within the scope of sports medicine. Each CPT code submitted by the candidates was then classified by anatomic location and subspecialty. By dividing the total number of procedures performed by the number of candidates submitting cases during a given year, we were able to calculate the cases per candidate for each category.

In addition to an analysis of procedures performed by candidates, the frequency and type of additional fellowship training (i.e., "dual fellowship") were recorded across all candidates who submitted cases. Case mix (i.e., sports medicine/arthroscopy, trauma/general, adult reconstruction, and "other") was determined for each category of dual fellowship-trained candidates. Individuals with >2 fellowships were also tabulated in this analysis, but case-level data were not interpreted since individuals with >2

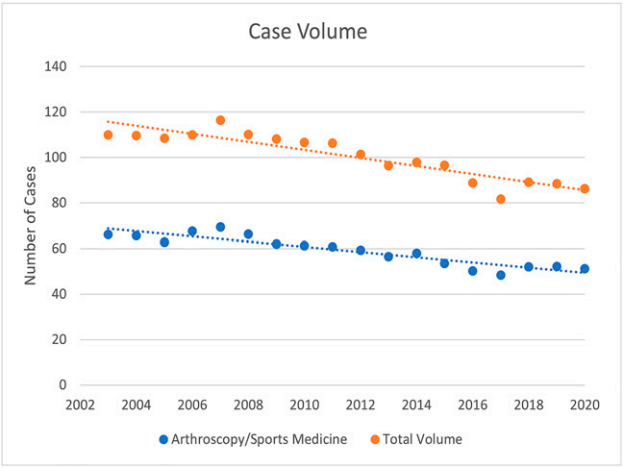

Fig. 1-A

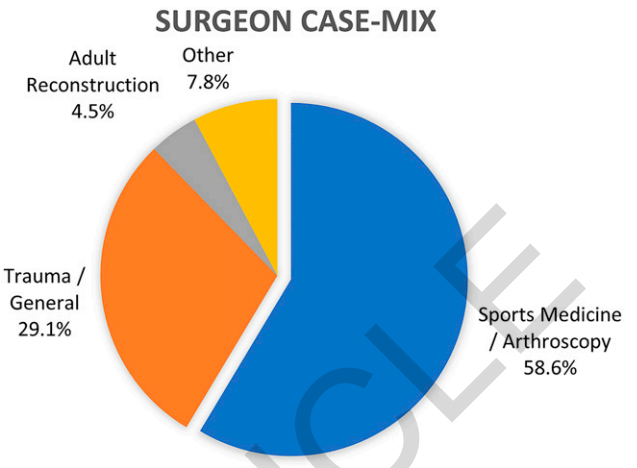

Fig. 1-B

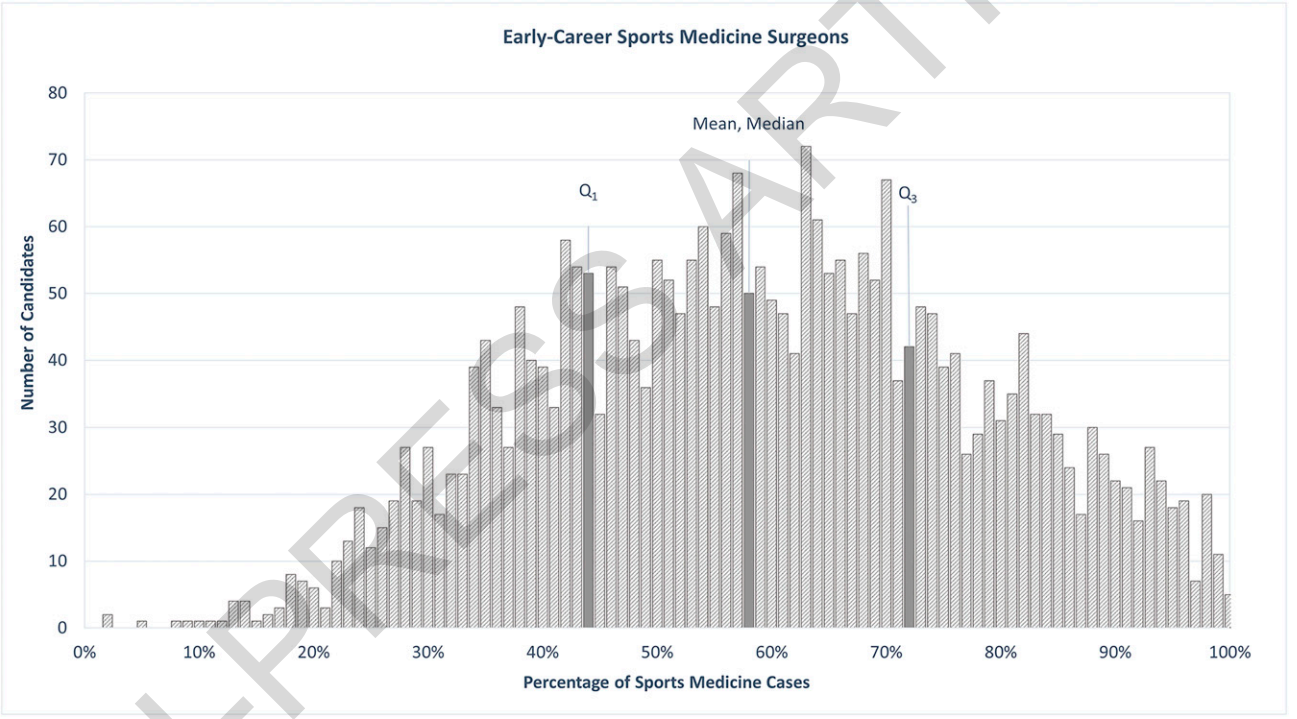

Fig. 1-C

Figs. 1-A, 1-B, and 1-C Case volume and case mix of sports medicine candidates. **Fig. 1-A** Annual number of arthroscopy/sports medicine (blue) and total (orange) cases, with the corresponding line of best fit (dotted lines), by candidates indicating completion of a sports medicine fellowship who submitted cases for the ABOS Part-II examination. **Fig. 1-B** Average proportion of cases, by case type, by candidates indicating completion of a sports medicine fellowship who submitted cases for the ABOS Part-II examination. **Fig. 1-C** Distribution of candidates by case mix. The solid lines represent the median and mean percentage of sports medicine/arthroscopy cases (58%) as well as the first quartile (Q1, 44%) and the third quartile (Q3, 72%).

fellowships comprise a small minority of all trainees and likely have a case mix that is not applicable to most sports medicine trainees.

Statistical Analysis

Descriptive statistical methods were used to describe the annual and overall procedure volume and the proportion of procedures performed by anatomic location and subspecialty. To reduce the impact of year-over-year variability in case mix, the descriptive statistics for the first 3 years of the study period (2003-2005) were compared with the final 3 years of the study period (2018-2020). Trends in the relative frequency of case volume were analyzed through linear regression analysis. Significance was defined as a p value of <0.05.

Source of Funding

No funding was received related to this publication.

TABLE I Cases/Candidate by Subspecialty Category for Individuals Indicating Sports Medicine Fellowship Training*

Subspecialty Category	Cases/Candidate 2003-2005	Cases/Candidate 2018-2020	% Change
Sports medicine/arthroscopy	64.8 (59%)	51.8 (59%)	−20%
Trauma/general	31.7 (29%)	25.7 (29%)	−19%
Adult reconstruction	4.3 (4%)	4.7 (5%)	+9%
Other	8.5 (8%)	5.7 (6%)	−33%
Total	109.3	87.9	−20%

*The values are given as the average, with the percentage of the total case mix in parentheses.

Results

Sports Medicine Candidates

A total of 12,691 candidates submitted 1,549,272 cases for the ABOS Part-II Oral Examination during the study period, with 3,298 candidates (26.0%) pursuing fellowship training in sports medicine. Of those candidates, 2,946 (89.3%) completed only a sports medicine fellowship, 333 (10.1%) completed dual fellowship training, and 20 individuals (0.61%) completed ≥3 fellowships.

Case Volume and Case Mix of Sports Medicine Candidates

On average, candidates with fellowship training in sports medicine submitted 100.6 cases for review during the 6-month case collection period: 58.9 (58.5%) sports medicine/arthroscopy cases, 29.3 (29.1%) trauma/general cases, 4.5 (4.5%) adult reconstruction cases, and 7.8 (7.8%) "other" cases per candidate (Figs. 1-A, 1-B, and 1-C; Table I). Less than 25% of sports medicine-trained candidates had at least 75% of their surgical volume in sports medicine/arthroscopy (Fig. 1-C). Although candidates performed fewer total ($r^2 = 0.84$, $p < 0.001$) and sports medicine/arthroscopy ($r^2 = 0.85$, $p < 0.001$) cases over the study period, the proportion of sports medicine/arthroscopy cases did not change over the study period ($p = 0.18$).

Patterns of Arthroscopy and Arthroplasty

The average number of shoulder, hip, and knee arthroscopy and arthroplasty cases per candidate was tabulated for sports medicine-trained ABOS candidates (Table II).

Fewer shoulder and knee arthroscopy cases and more hip arthroscopy cases per candidate were performed over the study period (see Appendix Supplemental Figure 1A); more hip and shoulder arthroplasty cases per candidate were performed over the study period (see Appendix Supplemental Figure 1B).

Dual-Fellowship Sports Medicine Candidates

A total of 333 candidates (10.1%) indicated dual fellowship training across 8 subspecialties: adult reconstruction (n = 61), foot and ankle (n = 61), hand and upper extremity (n = 42), oncology (n = 1), pediatrics (n = 52), shoulder and elbow (n = 46), spine (n = 12), and trauma (n = 58) (Fig. 2-A). Practice case mix differed among dual fellowship-trained candidates (Fig. 2-B). Dual fellowship-trained candidates in hand surgery performed 78.0% of cases on the upper extremity, while dual fellowship-trained candidates in shoulder and elbow surgery performed 40.1% of cases on the shoulder (see Appendix Supplemental Table 2). Dual fellowship-trained candidates in foot and ankle performed 54.7% of cases on the leg/ankle or foot/toes.

The number of dual fellowship-trained candidates pursuing additional fellowship training in pediatrics ($r^2 = 0.52$, $p < 0.001$) and adult reconstruction ($r^2 = 0.36$, $p = 0.007$) increased over the study period, and the number of dual fellowship-trained candidates pursuing additional fellowship training in trauma ($r^2 = 0.27$, $p = 0.03$) decreased over the study period. The rate of dual fellowship-trained candidates did not change significantly over the study period ($p = 0.12$).

Discussion

This study demonstrated that early-career sports medicine surgeons will perform approximately 200 cases per year, with >40% of the case volume consisting of general orthopaedics, trauma, and adult reconstruction cases. Although candidates performed a lower volume of both total and sports medicine/arthroscopy cases over the study period, the relative proportion of cases has remained unchanged since 2003. The rate of dual fellowship training has remained constant (approximately 10% of candidates) over time, although individuals were increasingly likely to pursue a second fellowship in adult reconstruction or pediatrics. To our knowledge, this is the first study that has reported the expected case mix and specialization patterns of early-career sports medicine surgeons, which provides relevant information for various members of the orthopaedic sports medicine community, including trainees selecting a subspecialty, fellowship directors optimizing or starting a training program, sports medicine surgeons developing a young practice, and practices hiring early-career sports surgeons.

TABLE II Cases/Candidate for Shoulder, Hip, and Knee Arthroscopy or Arthroplasty for Individuals Indicating Sports Medicine Fellowship Training*

Type of Procedure	Cases/Candidate 2003-2005	Cases/Candidate 2018-2020	% Change
Arthroscopy			
Shoulder	19.3 (18%)	15.2 (17%)	−21%
Hip	0.2 (<1%)	1.9 (2%)	+1,139%
Knee	37.6 (34%)	26.0 (30%)	−31%
Arthroplasty			
Shoulder	0.8 (1%)	2.6 (3%)	+243%
Hip	1.1 (1%)	1.6 (2%)	+45%
Knee	3.2 (3%)	3.1 (3%)	−3%

*The values are given as the average, with the percentage of the total case mix in parentheses.

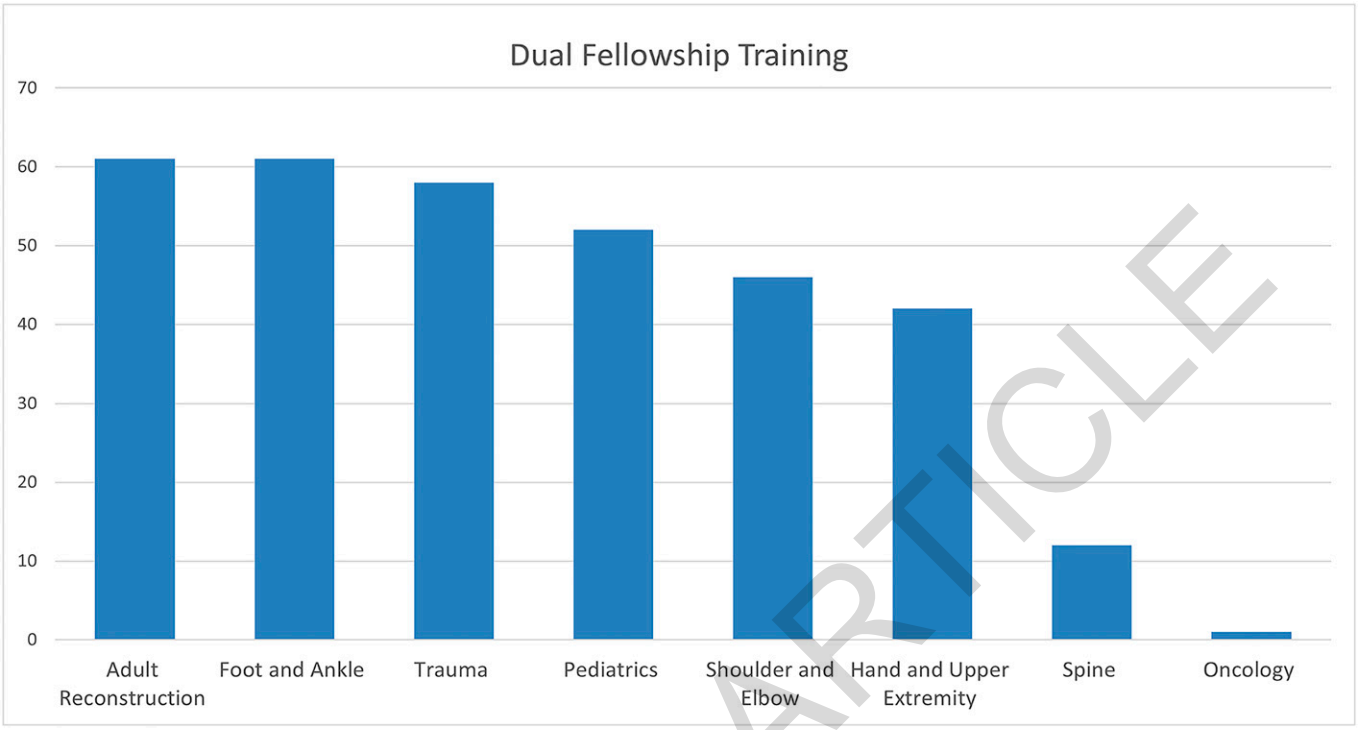

Fig. 2-A

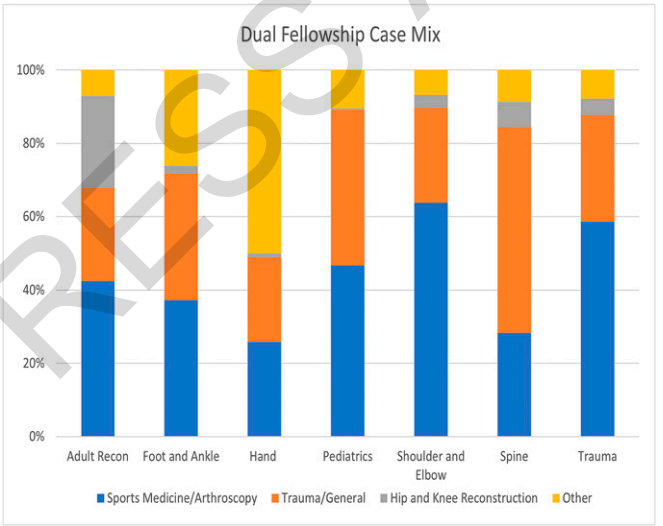

Fig. 2-B

Figs. 2-A and 2-B Dual fellowship training and case mix. **Fig. 2-A** Composition of dual fellowship-trained candidates by second fellowship. **Fig. 2-B** Case mix by second fellowship.

Often, residents and trainees enter the subspecialty of sports medicine based on experiences during residency training—experiences with high-volume subspecialized sports surgeons with mature academic practices. This study allows orthopaedic trainees and sports medicine fellows to understand the typical operative volume and case mix of young physicians. Although trainees can expect to perform up to 700 cases during a fellowship year[12], they will perform a substantially lower volume of total cases during early practice. Additionally, these individuals can expect to perform a large proportion of cases outside of their subspecialty area. Although both the volume and composition of cases may reasonably change as a young surgeon's practice matures, the average young surgeon's practice is, realistically, that of a generalist orthopaedic surgeon with an emphasis on sports medicine. Considering these practice patterns, joint replacement and

trauma cases may have a role in sports medicine fellowships to prepare graduates for early practice. At a minimum, trainees heading toward a sports medicine fellowship should recognize the importance of these types of rotations during their final years of residency.

The young sports medicine surgeon is performing fewer cases (both total and sports medicine cases) than in the past, although the number of sports medicine trainees has remained constant over the last 2 decades. Importantly, as fellowship-trained specialists enter the workforce, they replace a retiring workforce with a large number of generalist orthopaedic surgeons[2]. Therefore, the number of practicing sports medicine surgeons is likely increasing despite the relatively stable rate of fellowship trainees. Moreover, sports medicine trainees are likely competing for cases (e.g., hip arthroscopy[11,13] or shoulder arthroplasty[14]) that are increasingly performed by surgeons in different subspecialties. Compared with other subspecialties, sports medicine surgeons obtain and maintain surgical proficiency across numerous anatomic locations and modalities. Early-career surgeons may be hesitant to overly restrict their practice as they get started. Finally, improved understanding of treatment modalities for degenerative meniscal tears[15] and subacromial bursitis[16] has led to increased rates of nonoperative management for these conditions, which may be driving a decrease in arthroscopic knee and shoulder cases, respectively. As such, the decline in case volumes is likely multifactorial in nature and should not be overinterpreted as an indication of disequilibrium in the workforce.

Finally, approximately 10% of sports medicine surgeons pursue additional fellowship training beyond sports medicine. This rate of dual fellowship training is approximately double (4.5%)[4] that of the general orthopaedics community and has remained constant since 2003. Although increasing rates of dual fellowship training in pediatrics and sports medicine have been previously described[3,17], we also identified increasing rates of dual fellowship training in adult reconstruction. The implications for subspecialty training are highly variable with regard to the relative proportion of sports medicine cases performed. Despite the theoretical competitive advantages of a pediatric sports medicine pathway, these surgeons perform nearly 50% of cases outside of the subspecialty of sports medicine.

This study does possess limitations due to both the method of data collection and the population of interest. First, focusing on the initial 2 years of clinical practice may be myopic when considering the subspecialty of orthopaedic sports medicine as a career path since we cannot project the evolution of an early-career surgeon's practice as it matures. However, the ABOS database provides a reliable and thorough means to understand and describe this unique stage of a surgeon's career. Moreover, the analysis was dependent on the a priori classification of cases by CPT codes. However, this classification was applied uniformly across all of the years that were studied; therefore, it should not have affected temporal trends in case mix. Additionally, the classification was made specifically for an analysis of sports medicine surgeons and thus would err in overestimating the percentage of sports medicine cases performed. Another limitation was that some candidates seeking a sports medicine fellowship do so because of inadequate exposure to arthroscopic shoulder and knee procedures in residency, and they feel that such a fellowship will better prepare them for a general orthopaedic practice. We had no way to analyze the potential impact of this. However, these limitations should not prevent the appreciation of practice patterns for early-career sports medicine surgeons.

In conclusion, early-career sports medicine surgeons should expect to perform a substantial volume of general, trauma, and adult reconstruction cases, thereby entering a generalist practice with an emphasis on sports medicine. As such, trainees entering sports medicine should develop a strong foundation during rotations in these subspecialties throughout their orthopaedic residency. Moreover, recognizing the practice demands of early-career sports surgeons, fellowship directors may consider the value of adult reconstruction and/or trauma exposure. Additional work should be done to understand how a sports medicine surgeon's case mix matures over time and to determine what procedures sports medicine surgeons perform at different stages of their career.

Appendix

eA Supporting material provided by the authors is posted with the online version of this article as a data supplement at jbjs.org(http://links.lww.com/JBJS/H79). ■

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