The Experiential Benefit of an Orthopedic Trauma Fellowship: An Analysis of ACGME Case Log Data From 2006 to 2017

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OBJECTIVE: The Accreditation Council for Graduate Medical Education (ACGME) has published orthopedic case log data since the 2006/2007 academic year. Here, we use this data to analyze the variability in orthopedic trauma case experience reported by orthopedic trainees and to better understand the *impact* of an orthopedic trauma fellowship on *orthopedic surgical training*.

DESIGN, SETTING, AND PARTICIPANTS: Data were gathered from ACGME case log reports for orthopedic residents (reporting the cumulative case experience of graduating residents) and orthopedic trauma fellows (reporting the case experience of their fellowship year only) for all available years.

RESULTS: *The average* orthopedic trauma fellow reported significantly more trauma cases in multiple body regions ("Pelvis/Hip", "Femur/Knee", and "Foot/Toes") and "Open Complex" reductions (as defined by the ACGME) in their 1 year of fellowship than *the average* resident reported in their 5 years of residency.

CONCLUSION: *On average*, orthopedic trauma fellowships substantially increase the trauma case volumes of orthopedic trainees, especially with respect to lower extremity trauma. (J Surg Ed 76:1556–1561. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: education, fellowship, residency, orthopedic trauma, ACGME, case log

COMPETENCIES: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement

INTRODUCTION

The Accreditation Council for Graduate Medical Education (ACGME) has published resident case log data publicly since the 2006/2007 academic year.[1,2] These logs provide an opportunity to track the cases of residents longitudinally through time and comparatively between higher and lower case volume programs. As such, they allow objective identification of strengths, weaknesses, and trends in the resident operative experience. Additionally, when combined with fellow case log data, also published by the ACGME, they allow analysis of the relative contribution of fellowship training to the overall experience of orthopedic trainees. This information is important given the large body of literature tying case volume, and therefore experience, to surgeon skill and patient outcomes across a wide spectrum of procedures.[3-14]

Already a number of authors have used the ACGME case log data to identify trends in orthopedic resident case volumes through time and to point out significant disparities in the educational experience of residents.[15-23] For spine surgery in particular, resident case log data was compared to fellow case log data in an attempt to better understand the contribution of the fellowship year to the overall experience of trainees.[24] To our knowledge, a similar, comprehensive analysis of

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orthopedic resident and fellow case logs for orthopedic trauma has not been performed. Here, we have compiled the ACGME data available for trauma cases performed by orthopedic residents and orthopedic trauma fellows.[2] We have analyzed this data in an attempt to better define the additional operative experience provided by an orthopedic trauma fellowship.

METHODS

Data Gathered

ACGME case log reports for orthopedic residents (reporting the cumulative case experience of graduating residents) and orthopedic trauma fellows (reporting the case experience of their fellowship year only) were gathered for all available years (2006/2007-2016/2017 for residents, 2010/2011-2016/2017 for fellows). The average number of cases classified as "Fracture/Dislocation" cases by residents and fellows were gathered in total and for each individual body group ("Shoulder", "Humerus/Elbow", "Forearm/Wrist", "Hand", "Pelvis/Hip", "Femur/Knee", "Leg/Ankle", and "Foot/Toes").

Additionally, cases classified as "Open Simple" reductions or "Open Complex" reductions by the ACGME were gathered for residents and fellows. "Open Complex" reductions included fixation of calcaneal fractures, talus fractures, pilon fractures, bicondylar tibial plateau fractures, knee dislocations, acetabular fractures, pelvic ring injuries, perilunate injuries, distal humerus fractures, elbow fracture dislocations, scapular fractures, sternoclavicular joint dislocations, and nonunions. "Open Simple" reductions included the remainder of orthopedic trauma cases.

Statistics

Continuous variables were reported as a mean ± standard deviation and were compared with student *t* tests. Significance was defined by a p value of less than 0.05. All data and statistical analyses were performed using JMP Pro (version 13.0, SAS, Cary, North Carolina).

RESULTS

Demographics

The number of orthopedic residents included in the case log data increased through time, from 616 residents in 2006/2007 to 709 residents in 2016/2017. The number of orthopedic trauma fellows attending ACGME-accredited fellowships (included in the case log data) and the total number of orthopedic trauma fellows nationally remained stable through time. As of the 2016/2017 academic year, 14 out of 61 orthopedic trauma fellows attended ACGME accredited fellowships. ACGME case log data was available for residents from 2006 to 2017 and for fellows from 2010 to 2017.

There were no significant increases or decreases in the average number of total orthopedic trauma cases performed by residents or fellows during the study period (p = 0.58 for residents, p = 0.10 for fellows).

Experience Gained With an Orthopedic Trauma Fellowship

On average, orthopedic trauma fellows reported significantly more "Pelvis/Hip", "Femur/Knee", and "Foot/Toes" trauma cases in their 1 year of fellowship than residents reported in their 5 years of residency (Table 1). The *average* volume of cases reported by orthopedic trauma fellows during their fellowship year ranged from 12.8% (for "Hand", *3.2 cases vs 25 cases*) to 124.8% (for "Pelvis/Hip", *91.7 cases vs 73.5 cases*) of the *average volume of cases* reported by residents during the entirety of their residency.

On average, fellows reported significantly more cases classified as "Open Complex" reductions than residents

TABLE 1. Orthopedic Trauma Cases Logged by Residents (5 Year Residency) vs Fellows (1 Year Fellowship)

Body Region	Mean # of Trauma Cases Logged in 5 Years of Residency (*n* = 7325)	Mean # of Trauma Cases Logged in 1 Year of Fellowship (*n* = 116)	p Value	Volume of Cases Logged by Fellows vs Volume Logged by Residents
Shoulder	21.4 ± 14	14.8 ± 8.3	<0.0001	69.2%
Humerus/elbow	48.9 ± 21.3	27.1 ± 10.4	<0.0001	55.4%
Forearm/wrist	53.2 ± 25.6	23.4 ± 13.8	<0.0001	44.0%
Hand	25 ± 15.9	3.2 ± 5	<0.0001	12.8%
Pelvis/hip	73.5 ± 34.1	91.7 ± 30	<0.0001	124.8%
Femur/knee	61.9 ± 28.4	74.8 ± 25	<0.0001	120.8%
Leg/ankle	94.5 ± 36.8	75 ± 23.8	<0.0001	79.4%
Foot/toes	21.9 ± 15.1	25.5 ± 14	0.009	116.4%
Total trauma cases	400.3 ± 20.7	337.3 ± 22.2	<0.0001	84.3%

TABLE 2. Open Complex and Open Simple Reductions Logged by Residents (5 Year Residency) vs Fellows (1 Year Fellowship)

Reduction Complexity	Residents ($n = 709$)	Fellow ($n = 14$)	p Value	Volume of Cases Logged by Fellows vs Volume Logged by Residents
Simple	324.3 ± 91	250.9 ± 88	<0.01	77.4%
Complex	47.5 ± 22	134 ± 33	<0.01	282.1%

(Table 2). The *mean* volume of "Open Complex" reductions reported by orthopedic trauma fellows during their fellowship year was 134 cases; the mean volume of "Open Complex" reduction cases reported by residents during their 5 years of residency was 47.5.

DISCUSSION

The major finding of this study is that orthopedic trauma fellowships substantially increase the trauma case volumes of orthopedic trainees, especially with regard to lower extremity trauma. Notably, the average resident completing an orthopedic trauma fellowship would be expected to more than triple their experience with "Open Complex" reductions, as defined by the ACGME, during their fellowship year (Table 2).

This information is important, given the large body of literature tying case volume to surgeon skill and patient outcomes across a wide spectrum of procedures.[3-14] As might be expected, for technically demanding trauma procedures, including acetabular, distal femur, and calcaneal fracture open reduction internal fixation, patient outcomes have been correlated with surgical experience.[7-9] Patient outcomes *have* also been correlated with surgeon experience for cases which are traditionally considered less demanding, such as hip hemiarthroplasty and intertrochanteric femur fracture fixation.[10-11] While data linking case log data to resident performance is limited in the orthopedic literature, radiology and general surgery resident case volumes have been found to correlate positively with radiograph interpretation and operating room skills, respectively.[12,13]

The studies above suggest that the experience gained during an orthopedic trauma fellowship year could translate into better outcomes for patients. This likely applies to complex orthopedic trauma procedures, but possibly even to trauma procedures and orthopedic injuries which are traditionally considered less complex. With an increasing supply of fellowship trained orthopedic traumatologists, this may lead to improved care of injured patients in general, provided appropriate referral practices are in place.[25]

A secondary finding of this study is the wide discrepancy in trauma case volumes reported by orthopedic residents and orthopedic trauma fellows, as evidenced by the large standard deviation values obtained from the ACGME data. This has previously been reported for by Blood et al., using resident data from 2009 to 2013.[21] Other authors have found a similarly significant discrepancies in case volumes for microsurgical, hand fracture, arthroscopic, orthopedic oncologic, pediatric orthopedic, and foot and ankle cases.[14-19,23] These discrepancies reveal real differences in the training received by orthopedic residents and fellows, and present an opportunity for improvement in the training of orthopedic surgeons. Encouragingly, Gil et al. found a narrowing gap between the case numbers logged by 10th and 90th percentile orthopedic residents from 2009 to 2013.[22] Further work would be needed to test whether that trend has continued.

Notably, trauma fellows performed relatively few upper extremity cases, especially hand cases, during fellowship when compared to the average residency experience. While this may be due to an emphasis on lower extremity trauma during fellowship, it is possible that this is the result of upper extremity and hand cases being preferentially performed by fellows from other subspecialties.

Regardless of the cause, this may not be a bad thing. Orthopedic residency is ideally designed to promote competency in the basic skills and procedures of all orthopedic subspecialties. An orthopedic trauma fellowship, on the other hand, is ideally designed to provide specific training for cases that an orthopedic trauma surgeon will be expected to manage. As such, we should expect some quantitative and qualitative differences in the kinds of cases logged by orthopedic residents and orthopedic trauma fellows.

It is important that the bodies which accredit fellowship programs work to identify the types of cases that their fellows will be asked to care for in practice and ensure that they are being trained appropriately for those cases. Those cases which are frequently treated by other surgeons, such as hand trauma, can potentially be de-emphasized. Meanwhile, those cases which are becoming more common, such as lumbopelvic fixation, can potentially be promoted as a more important part of the fellowship curriculum.

This study has a number of weaknesses. For one, our data was gathered only from ACGME certified residency

and fellowship programs. While the majority of residency programs are ACGME accredited, the same is not true for orthopedic trauma fellowships. As noted above, a little less than a third of orthopedic trauma fellows attended ACGME certified fellowships. Many other orthopedic trauma fellowships track case log data through the Orthopedic Trauma Association, but the differences between their case logs and those kept by the ACGME makes direct comparisons difficult. It is therefore unclear whether the findings of this study apply generally to the experience of all orthopedic trauma fellows.

Another weakness of this study is its reliance on resident and fellow case logs as a marker for experience gained during training. While this seems like a reasonable assumption in theory, there are a number of studies showing that case logging is imperfect in practice, with reported error or omission rates of 24% to 48%.[26-31] If the ACGME logs are that inaccurate, any conclusions based on ACGME case log data, including ours, would have to be interpreted with caution. It should be noted, however, that certain types of cases, specifically operating room cases performed by senior residents, have reported logging error rates as low as 4%.[32,33]

Nonoperative experience in orthopedic trauma, including closed treatment of fractures with or without reduction, is likely underreported in this data set. This probably has a disproportionate effect on the data for body areas where many fractures are treated nonoperatively, such as "Hand". Additionally, there may be logging discrepancies related to combined injuries involving multiple discrete injuries. For example, Lis Franc injuries could be logged simply as a single combined midfoot open reduction internal fixation or as multiple individual midfoot injuries treated with open reduction internal fixation.

Even if case logs correlated exactly with actual case volumes, a simple analysis of case experience is itself an imperfect measure of training quality. Instead, case volume is just 1 factor among many others, including mentorship, didactics, learning environment, training program attended, and the personal characteristics of the trainee in question, which determine the overall quality of training received during residency or fellowship.

CONCLUSION

On average, orthopedic trauma fellowships substantially increase the trauma case volumes of orthopedic trainees, especially with respect to lower extremity trauma.

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