National Trends in Orthopaedic Surgery Resident Adult Case Logs

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OBJECTIVE: Our purpose was to assess United States data to determine if there were changes in the number of adult cases that graduating orthopaedic surgery resident logged.

DESIGN: We assessed the Accreditation Council for Graduate Medical Education data from 2010 to 2016 to identify the number of cases that were reported by graduating orthopaedic surgery residents through the United States. Specifically, we analyzed the mean total number of adult cases per graduating resident. We substratified the data based on the subspecialty to include total number of cases performed in: (1) upper extremity; (2) lower extremity; (3) spine; (4) oncology; and (5) trauma.

SETTING: All data collection was performed at the Seton Hall School of Health and Medical Sciences.

PARTICIPANTS: All United States orthopaedic surgery residents were considered participants

RESULTS: During the study period, the total number of cases performed by each resident had decreased from 1791 to 1311 ($p = 0.0001$). There was only an increase in the number of pelvis/hip cases ($p = 0.0001$). Among upper extremity cases, there was a decrease in each subtype of cases ($p = 0.0001$). There was a decrease in the number of femur/knee, leg/ankle, and foot/toes cases per resident ($p = 0.0001$). Furthermore, there was a decrease in the number of spine and trauma cases performed ($p = 0.0001$). There was no difference in the number of oncology cases performed ($p = 0.47$).

CONCLUSIONS: We noted a decrease in the number of cases logged by graduating residents over the past 6 academic years. This provides a great deal of insight into the need for residencies to ensure that the appropriate Accreditation Council for Graduate Medical Education bench marks are met. Future studies should analyze how cases may be increased. (J Surg Ed 76:893–897. © 2019 Published by Elsevier Inc. on behalf of Association of Program Directors in Surgery.)

KEY WORDS: orthopaedic surgery, resident education, case logs, ACGME, residency

COMPETENCIES: Practice-Based Learning and Improvement, Medical Knowledge, System-Based Practice

INTRODUCTION

Effective training throughout the orthopaedic surgery residency is predicated on performing the appropriate amount and diversity of cases. As such, it is imperative that residents are exposed to a variety of cases in order to meet the requirements and benchmarks set by the Accreditation Council for Graduate Medical Education (ACGME). With incorporation of work hour restrictions in 2005, there were concerns that residents would not be able to meet the ACGME case requirements.[1] Although the strengths in case-loads for residencies across the country vary based on a number of factors, it is imperative that programs continue to evaluate ways to continue to improve on the number of cases performed by residents to ensure training that facilitates their ultimate independence as practitioners.

There have been previous studies that have shown variability in the number of case and the variability of types of cases that are being performed by orthopaedic surgery residents in the United States.[2-6] However, given the continued changes in duty hours and the increase in the number of orthopaedic surgery residents within the United States, there remains a need for an updated analysis on the number of cases each resident may perform during their training.

Therefore, the purpose of this study was to assess the number of mean cases per orthopaedic surgery resident that were performed between over the last 6 academic

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years. Specifically, we evaluated: (1) total adult; (2) upper extremity; (3) lower extremity; (4) spine; (5) oncology; and (6) trauma cases per graduating resident.

METHODS

Appropriate Institutional Review Board approval was obtained prior to the initiation of this study. The resident case logs of all orthopaedic surgery residency programs between the academic years of 2010 and 2016 within the United States were queried. All adult cases were identified and tabulated. They were further subclassified into the following categories: (1) shoulder; (2) humerus/elbow; (3) forearm/wrist; (4) hand/fingers; (5) pelvis/hip; (6) femur/knee; (7) leg/ankle; (8) foot/toes; (9) spine; (10) oncology; and (11) trauma.

We analyzed the mean number of cases per resident performed total and within each category between 2010 and 2016 for any potential differences. In addition, we evaluated the data regarding the differences in the number of mean cases per resident that were in the 10th and 90th percentile for total amount as well as the aforementioned subclassifications.

All data were inputted into a Microsoft Excel spreadsheet (Excel, Microsoft Corporation, Redmond, Washington). Graph Pad Prism version 5.01 (GraphPad Software Inc., La Jolla, California), was used for all statistical calculations, and student's *t* test was used to compare the difference among the means at different time points. A 95% confidence interval (CI) in the mean difference per year was calculated. A p value of less than or equal to 0.05 was considered significant.

RESULTS

Between 2010 and 2016, there were substantially lower mean total adult cases performed by each resident (mean = 1791-1311 cases per resident; 95% CI, 439.25-520.75; p = 0.0001). During this time, there has been a substantial difference between the 10th and 90th percentile mean cases per resident for each year (p = 0.0001; Fig. 1).

Additionally, there has been a change in the number of upper extremity cases performed during this time-period. Specifically, there was a decrease in the number of cases seen in shoulder (191-130 cases per resident; 95% CI, 53.24-68.76; p = 0.0001), humerus/elbow (58-48 cases per resident; 95% CI, 7.85-12.15, p = 0.0001), forearm/wrist (109-91 cases per resident; 95% CI, 13.71-22.29; p = 0.0001), and hands/fingers cases (110-80 cases per resident; 95% CI, 25.15-34.85; p = 0.0001; Table 1).

Lower extremity cases saw increases in a certain type of case with decreases in the remaining subtypes. Specifically, there was an increase in the number of pelvis/hip cases performed (183-199 cases per resident; 95% CI, 9.06-22.94; p = 0.0001). There was a decrease in the

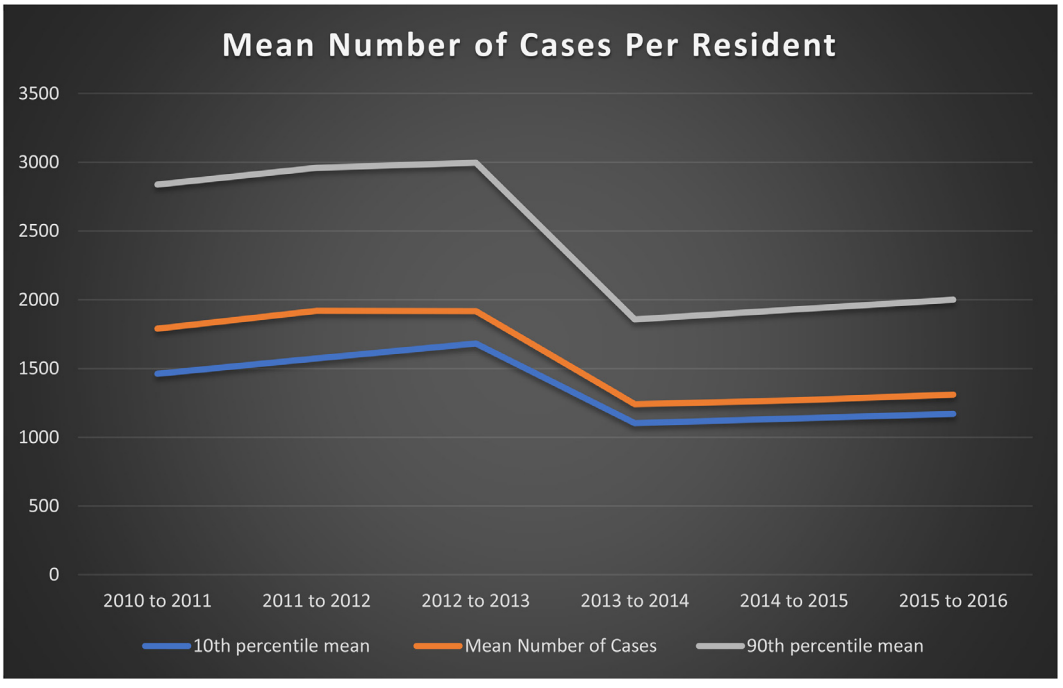

FIGURE 1. Total number of cases showing decrease in mean number.

TABLE 1. Mean Upper Extremity Cases Performed

Academic Years	Shoulder ± SD	Humerus/elbow ± SD	Forearm/Wrist ± SD	Hand/Fingers ± SD
2010-2011	191 ± 91	58 ± 23	109 ± 45	110 ± 53
2011-2012	208 ± 101	60 ± 27	112 ± 49	113 ± 58
2012-2013	211 ± 95	59 ± 22	113 ± 42	111 ± 49
2013-2014	120 ± 46	45 ± 16	87 ± 35	76 ± 36
2014-2015	123 ± 48	47 ± 17	88 ± 33	78 ± 36
2015-2016	130 ± 50	48 ± 17	91 ± 35	80 ± 37
p value	0.0001	0.0001	0.0001	0.0001
95% CI, mean difference	53.24-68.76	7.85-12.15	13.71-22.29	25.15-34.85

TABLE 2. Mean Lower Extremity Cases Performed

Academic Years	Pelvis/Hip	Femur/Knee	Leg/Ankle	Foot/Toes
2010-2011	183 ± 65	390 ± 119	171 ± 58	86 ± 49
2011-2012	198 ± 77	417 ± 152	179 ± 70	94 ± 64
2012-2013	200 ± 65	401 ± 113	173 ± 59	91 ± 50
2013-2014	183 ± 61	301 ± 80	126 ± 44	51 ± 27
2014-2015	190 ± 67	304 ± 88	131 ± 42	55 ± 28
2015-2016	199 ± 65	310 ± 83	139 ± 43	57 ± 26
p value	0.0001	0.0001	0.0001	0.0001
95% CI, mean difference	9.06-22.94	69.12-90.88	26.58-37.42	24.86-33.14

number leg/knee (390-310 cases per resident; 95% CI, 69.12-90.88; p = 0.0001), leg/ankle (171-139 cases per resident; 95% CI, 26.58-37.42; p = 0.0001), and foot/toes cases performed (86-57 cases per resident; 95% CI, 24.86-33.14; p = 0.0001; Table 2).

There was a decrease in the number of spine cases performed per resident from 137 to 62 cases per resident (95% CI, 66.76-83.24; p = 0.0001). There was no difference in the number of oncology cases performed (31-32 cases per resident; p = 0.47). However, the number of trauma cases per resident decreased from 416 to 388 (95% CI, 11.74-44.26; p = 0.0007).

See Table 3 for a detailed analysis of the differences between the 10th and 90th percentile cases per resident for the total and types of cases.

DISCUSSION

The ability to practice medicine independently is predicated on having the appropriate volume of cases. Thus, it is imperative to ensure that all orthopaedic surgery residents are performing at or beyond what are considered the minimum case requirements set out by the ACGME.

TABLE 3. Fold Difference Between 10th and 90th Percentile Cases

Case Type	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Shoulder	3.24	3.15	3.30	2.80	2.74	2.66
Humerus/elbow	2.67	2.81	2.50	2.44	2.63	2.63
Forearm/wrist	2.93	2.80	2.72	2.69	2.66	2.69
Hand/fingers	3.49	3.33	3.42	3.13	3.21	3.51
Pelvis/hip	2.48	2.42	2.24	2.33	2.25	2.24
Femur/knee	2.19	2.11	2.03	2.03	2.08	1.93
Leg/ankle	2.41	2.46	2.39	2.51	2.27	2.18
Foot/toes	4.45	4.50	3.79	3.86	3.68	3.25
Spine	9.41	7.35	6.18	4.09	4.35	4.58
Oncology	71.00	27.00	7.82	6.67	5.00	4.83
Trauma	2.75	2.59	2.34	2.32	2.29	2.32
Total all procedures	1.94	1.88	1.84	1.72	1.78	1.78

Therefore, aimed to determine if the mean case-loads of residents over 6 academic years have experienced any changes. We noted an overall decrease in the number of cases being performed by residents over the past 6 academic years with a notable difference between those within the 10th and 90th percentiles for each type of case as well as the total number of cases. The most prominent decrease came between 2012 and 2014 with a slight increase occurring between 2014 and 2016. The implications of these findings are crucial as the overall decrease in cases has a deleterious effect on the ability of residency programs to train physicians who can practice independently.

Our study has several limitations. It is possible that the case-loads may not be accurately reported by residents or precisely tracked by ACGME. Secondly, the ACGME does not make publicly available the number of residents who are unable to meet their minimum case log criteria. However, we would speculate that the vast majority of residents meet their minimum case benchmarks in order to continue their accreditation. Furthermore, we were unable to glean program-specific information regarding cases. For instance, some programs may have more of a case volume regarding certain type of cases as oppose to others. Additionally, programs located within different regions of the country or a larger number of residents may have differences in the volume of cases performed. Moreover, the drop in case logs due to performance of some of cases in surgery centers may not fully explain in the decrease in case volumes for procedures not typically performed at outpatient surgical centers. Despite these limitations, we believe that this study represents an updated picture regarding the cases residents will perform prior to graduating their residency.

Our study contradicts 1 previously published study that showed an overall increase in cases per resident. Gil et al. evaluated the resident case logs from 2007 to 2013.[2] They found that there was a 17% increase in the total number of adult cases performed by residents during that time period (1953-2291 cases per resident; $p = 0.0004$). Additionally, there was an increase in each type of case performed: shoulder (167-218 cases per resident; $p = 0.0001$), humerus/elbow (81-94 cases per resident; $p = 0.001$), forearm/wrist (136-153 cases per resident; $p = 0.0001$), hands/fingers (123-127 cases per resident; $p = 0.01$), pelvis/hip (206-225 cases per resident; $p = 0.006$), femur/knee (427-453; $p = 0.03$), leg/ankle (203-214 cases per resident; $p = 0.01$), foot/toes (110-114 cases per resident; $p = 0.009$), spine (145-181 cases per resident; $p = 0.009$), and oncology (29-52 cases per resident; $p = 0.003$). In our study, the only cases that increased over our study period were pelvis/hip. Furthermore, the decrease in cases seen was most pronounced between 2012 and 2014 with slight increase seen between 2014 and 2016. The difference in our findings may be attributed to several factors. There has been an increase in the number of same-day surgical centers, which has been driven by cost savings.[7,8] Although we cannot be sure why there was a drop in case logs, it may be speculated that cases that may have originally been performed in inpatient centers are now being performed in these outpatient surgery centers. Thus, residents may not have the ability to perform cases during the time which there was a decrease in number of cases logged. Additionally, the increase in the number of graduating residents—650 to 705—may also be causing a decrease in the number of cases performed. Furthermore, although it cannot be proven, some trauma cases that were originally managed at academic trauma centers are now being managed by orthopaedic traumatologists at nonacademically affiliated hospitals.

Among each case subtype, the 1 type of case where there was an increase over our study time period was in pelvis/hip cases. It is not clear what may be the reason behind this anomalous finding. However, it is known that the number of total hip arthroplasties performed in the United States is expected to increase by 173% from 2005 to 2030.[9] It is quite possible given that the majority of total hip arthroplasties are still performed in the inpatient setting, this allowed for an increase in resident exposure to pelvis/hip cases.

In conclusion, we found an overall decrease in the number of adult cases being performed by residents. We believe that this decrease in cases performed by graduating residents is multifactorial. This change provides a great deal of insight into the need for residencies to ensure that the appropriate ACGME bench marks are being met for cases. Furthermore, residency programs must continue to explore ways to increase the amount of cases residents are exposed to so they may be capable of practicing independently. Future studies should focus on cases performed based on program location and size of residency.

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