Resident Exposure to Peripheral Nerve Surgical Procedures During Residency Training

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ABSTRACT

Background Variability in case exposures has been identified for orthopaedic surgery residents. It is not known if this variability exists for peripheral nerve procedures.

Objective The objective of this study was to assess ACGME case log data for graduating orthopaedic surgery, plastic surgery, general surgery, and neurological surgery residents for peripheral nerve surgical procedures and to evaluate intraspecialty and interspecialty variability in case volume.

Methods Surgical case logs from 2009 to 2014 for the 4 specialties were compared for peripheral nerve surgery experience. Peripheral nerve case volume between specialties was performed utilizing a paired *t* test, 95% confidence intervals were calculated, and linear regression was calculated to assess the trends.

Results The average number of peripheral nerve procedures performed per graduating resident was 54.2 for orthopaedic surgery residents, 62.8 for independent plastic surgery residents, 84.6 for integrated plastic surgery residents, 22.4 for neurological surgery residents, and 0.4 for surgery residents. Intraspecialty comparison of the 10th and 90th percentile peripheral nerve case volume in 2012 revealed remarkable variability in training. There was a 3.9-fold difference within orthopaedic surgery, a 5.0-fold difference within independent plastic surgery residents, an 8.8-fold difference for residents from integrated plastic surgery programs, and a 7.0-fold difference within the neurological surgery group.

Conclusions There is interspecialty and intraspecialty variability in peripheral nerve surgery volume for orthopaedic, plastic, neurological, and general surgery residents. Caseload is not the sole determinant of training quality as mentorship, didactics, case breadth, and complexity play an important role in training.

Introduction

Surgeons completing residency training in orthopaedic surgery, plastic surgery, neurological surgery, and general surgery currently perform peripheral nerve surgeries in the United States.^{1,2} The Accreditation Council for Graduate Medical Education (ACGME) requires training in the diagnosis and management of peripheral nerve problems during orthopaedic surgery, plastic surgery, and neurological surgery residency programs,³ while no such requirement exists for general surgery residency training programs.⁴ Correspondingly, case minimums have been established for peripheral nerve surgeries by the ACGME for orthopaedic surgery, neurological surgery, and plastic surgery residents.^{3,5,6}

Currently, plastic surgeons, orthopaedic surgeons, and general surgeons interested in subspecializing in hand surgery are likely to pursue further training in a hand and upper extremity fellowship where 1 area of emphasis is peripheral nerve surgery.¹ On the contrary, neurological surgery exposure to peripheral nerve procedures is generally limited to residency

training given that the opportunity to pursue additional training in peripheral nerve surgery is limited.⁷

The objective of this study was to assess ACGME case log data for graduating orthopaedic surgery, plastic surgery, general surgery, and neurological surgery residents for peripheral nerve surgical procedures, as well as to evaluate the overall level of intraspecialty and interspecialty variability in exposure to peripheral nerve procedures.

Methods

ACGME surgical case logs from 2009 to 2014 for graduating plastic surgery, orthopaedic surgery, neurological surgery, and general surgery residency were assessed and compared for peripheral nerve surgery case volume.^{8–37} In 2008–2009, the ACGME began to distinguish plastic surgery programs that designated themselves as independent or integrated. Residents in integrated programs complete 6 years of ACGME-accredited plastic surgery education without completing a prerequisite curriculum, whereas residents in independent programs complete 3 years of plastic surgery education after completing a prerequisite

curriculum in an ACGME-accredited general surgery, orthopaedic surgery, otolaryngology, or urology residency program.³⁸

The ACGME orthopaedic surgery case log reports categorized peripheral nerve procedures as “neuroplasty,” “transection or avulsion,” “incision/excision-nerve,” “neurorrhaphy,” “other-nerve,” “carpal tunnel,” and “total-nerve.” The ACGME neurological surgery case log reports categorized peripheral nerve procedures as “neurolysis/transposition,” “nerve repair,” “sympathectomy,” “nerve stimulation,” “peripheral nerve section/rhizotomy,” “excision tumor/neuroma/neurolytic agent/other,” and “total-peripheral nerve procedures.” ACGME independent plastic surgery and integrated case log reports subcategorized peripheral nerve procedures within the “hand” category as “nerve repair” and “nerve decompression.” The plastic surgery logs did not include an average total peripheral nerve procedures per resident subcategory. In this analysis, the plastic surgery average total peripheral nerve procedures per resident was the sum of the average “nerve repair” and “nerve decompression” per resident to allow for comparisons with neurological surgery, orthopaedic surgery, and general surgery residents. The ACGME surgery case log reports categorized peripheral nerve procedures as “hand-nerve repair or vascular repair,” “hand-nerve repair,” “orthopaedics-repair or transfer of tendon/nerve,” “trauma-repair tendon or nerve,” and “nervous system-nerve root/peripheral nerve decompression.” The ACGME surgery logs did not include an average total peripheral nerve procedures per resident subcategory, and the general surgery average total peripheral nerve procedures per resident was the sum of the peripheral nerve related categories reported in the logs to facilitate comparisons with plastic surgery, neurological surgery, and orthopaedic surgery residencies.

This study was deemed to be exempt from Institutional Review Board approval.

Statistical comparisons of average peripheral nerve procedures between specialties was performed using a paired *t* test with a cutoff of $P < .05$ for significance, and 95% confidence intervals were calculated for each specialty. Tenth and 90th percentile peripheral nerve case volume was also compared for each specialty. Linear regression was calculated to assess the trends of the average total peripheral nerve procedures performed per resident in each specialty. Analysis of variance was calculated to assess the significance of these trends with $P < .05$ for significance. Each year of data from 2009 to

What was known and gap

There is variability in case exposure in some areas of surgical training, yet no studies have assessed this for peripheral nerve procedures.

What is new

A study found interspecialty and intraspecialty variability in peripheral nerve procedure volume for orthopaedic surgery residents and residents in 4 other specialties.

Limitations

Case log data may have inaccuracies due to overreporting or underreporting.

Bottom line

While there was variability in residents' exposure, mentorship, didactics, and case breadth and complexity also play important roles.

2014 was included in this analysis. Statistical analysis was performed utilizing Microsoft Excel (Microsoft Corp, Redmond, WA) and StatPlus: LE (AnalystSoft Inc, Walnut, CA).

Results

The 4 surgical specialties all reported peripheral nerve surgery data to the ACGME case log system for graduating residents (TABLE 1). The orthopaedic surgery resident peripheral nerve case volume was significantly higher than that for neurological surgery ($P < .001$) and general surgery residents ($P < .001$). Orthopaedic surgery resident volume was lower than that for integrated plastic surgery residents ($P < .001$) and not significantly different from that of independent plastic surgery residents ($P = .14$; FIGURE 1; TABLE 2).

Within the orthopaedic surgery resident group, the bottom 10% reported 26 total peripheral nerve procedures per resident, while the top 10% reported 102 procedures, representing a 3.9-fold difference. Within the plastic surgery resident group from independent residencies, the bottom 10% reported 22 total peripheral nerve procedures per resident, while the top 10% reported 111 procedures, representing a 5.0-fold difference. Within the plastic surgery resident group from integrated residencies, the bottom 10% reported 21 total peripheral nerve procedures per resident, and the top 10% reported 184 procedures, representing an 8.8-fold difference. Within the neurological surgery resident group, the bottom 10% reported 6 total peripheral nerve procedures per resident, while the top 10% reported 42 procedures, representing a 7.0-fold difference (FIGURE 2).

TABLE 3 shows changes in the mean total peripheral nerve procedures reported for a graduating

TABLE 1
Program Demographics

Graduating Year	No. of Residency Programs	No. of Residents
Orthopaedic surgery		
2009	148	635
2010	147	653
2011	148	650
2012	149	675
2013	150	678
2014	151	684
Plastic surgery (independent)		
2009	72	155
2010	72	152
2011	69	141
2012	64	142
2013	38	75
2014	65	130
Plastic surgery (integrated)		
2009	21	39
2010	22	43
2011	25	53
2012	26	55
2013	28	59
2014	28	61
Neurological surgery		
2009	85	147
2010	89	159
2011	88	154
2012	87	147
2013	90	178
2014	91	159
General surgery		
2009	244	1044
2010	242	1040
2011	240	1060
2012	242	1092
2013	240	1098
2014	243	1105

resident in the 4 specialties between 2009 and 2014. This shows that orthopaedic surgery residency increased 15% between 2009 and 2013, but then fell 32% between 2013 and 2014. Independent plastic surgery residency increased 34% from 2009 to 2014. Integrated plastic surgery residency increased 18% from 2009 to 2014. Neurological surgery residency increased 24% from 2009 to 2014. General surgery residency decreased 67% from 2009 to 2014.

TABLE 2
Total Peripheral Nerve Procedures Reported per Graduating Resident^a

Residency Program	Total Peripheral Nerve Procedures
Orthopaedic surgery	54.2 (48.4–59.9)
Plastic surgery (independent)	62.8 (56.4–69.2)
Plastic surgery (integrated)	84.6 (79.5–89.7)
Neurological surgery	22.4 (20.5–24.4)
General surgery	0.4 (0.2–0.6)

^a The values are given as the mean number of total peripheral nerve procedures performed per graduating resident by each group, with the 95% confidence intervals in parentheses.

Discussion

We found a significant intraspecialty variability in total peripheral nerve surgery exposure. In 2012, orthopaedic surgery residents had a 3.9-fold difference in total peripheral nerve cases between the top and bottom 10% of residents, plastic surgery residents from independent programs had a 5.05-fold difference, plastic surgery residents from integrated programs had a nearly 9-fold difference, and neurological surgery residents had a 7-fold difference.

The data revealed that general surgery and neurological surgery residents were exposed to significantly fewer total peripheral nerve procedures compared to plastic surgery and orthopaedic surgery residents. Generally, orthopaedic surgery, plastic surgery, and general surgery residents complete subspecialty fellowships and obtain additional experience in peripheral nerve surgery. On the contrary, neurological surgery graduates commonly perform peripheral nerve procedures without additional fellowship training. Previous investigations have examined peripheral nerve surgery experience in neurological surgery trainees. A 2004 study found that that only 49% of 1700 neurosurgeons believed that their exposure to peripheral nerve procedures during residency was adequate, although an overwhelming majority (97%) reported that peripheral nerve procedures should remain a part of the neurological surgery residency curriculum.² Additionally, 76% of these neurosurgeons referred complex peripheral nerve procedures to other neurosurgeons.²

Despite the inherent variability in training exposure, the ACGME mandates that during residency, orthopaedic and neurological surgery residents perform no fewer than 10 peripheral nerve procedures, and plastic surgery residents no fewer than 26 peripheral nerve procedures during residency.^{3,5,6}

FIGURE 1
Mean Total Peripheral Nerve Procedures per Resident

Recent interest in the assessment of technical competence of residents rather than pure volume of cases may raise questions regarding the validity of these arbitrary minimums. In 1 survey of an orthopaedic residency program, directors and residents agreed that surgical skill laboratories and simulation technology could help trainees achieve technical competence,³⁹ and another study demonstrated that a web-based knowledge test combined with a cadaveric surgical skills lab could distinguish between novice and senior residents performing open carpal tunnel surgery.⁴⁰ Future research is needed to determine the optimal training volume and appropriate case minimums for residents regarding peripheral nerve surgery, especially in light of the variable rate at which trainees obtain competence and variability in case breadth and complexity between programs.

This study has several limitations. First, there may be problems with the accuracy of case tracking and the

ACGME case log data may not represent the true exposure to peripheral nerve surgery for residents due to underreporting or overreporting of cases.^{41,42} However, data are being monitored closely by the ACGME.⁴² In addition, the lack of specificity of case type in the ACGME data limits detailed tracking of peripheral nerve procedures. Finally, to facilitate inclusion of plastic surgery and surgery trainees, it was necessary to use total peripheral nerve procedures per resident due to the lack of uniformity of reporting types of cases. The absence of a minimum requirement for peripheral nerve procedures for general surgery may have led to underreporting of peripheral nerve procedures by these residents. Finally, as we did not perform a correction for multiple associations, some observed differences may have been due to chance.

Conclusion

We demonstrated significant intraspecialty and interspecialty variability in peripheral nerve surgery

FIGURE 2
2012 10th and 90th Percentile Peripheral Nerve Case Volume

TABLE 3

Changes in Total Peripheral Nerve Procedures 2009 Through 2014

	2009	2013	2014
Orthopaedic surgery	53.2	61.2 (15%)	41.4 (–32%) ^a
Plastic surgery independent program	55.1		73.9 (34%)
Plastic surgery integrated program	76.7		90.3 (18%)
Neurological surgery	20.5		25.5 (24%)
General surgery	0.9		0.3 (67%)

^a Change 2013 to 2014.

training. We also found a lack of consistency in the reporting of peripheral nerve procedures between specialties. Beyond caseload, mentorship, didactics, case breadth, and complexity play key roles in surgeon training. Competency-based training may potentially become an increasingly important role in the future of surgeon training.

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