

ACGME Case Volume Minimums Decrease the Number of Shoulder and Knee Arthroscopies Performed by Residents



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Purpose: The purpose of this study was to examine how the implementation of Accreditation Council of Graduate Medical Education (ACGME) case minimums in 2013 has affected the number of shoulder and knee arthroscopies performed by orthopaedic surgery residents during their clinical training. **Methods:** The ACGME orthopaedic surgery case log data from graduation years 2007 to 2019 was used to evaluate the number of shoulder and knee arthroscopies performed. The mean and median number of cases performed per resident were compared for the years prior to implementation of the ACGME case minimum (2007-2012) and after (2013-2019). **Results:** The ACGME orthopaedic surgery case minimums resulted in a significant decrease in the mean number of shoulder and knee arthroscopies performed. The mean number of shoulder arthroscopies performed in the years before and after the case minimum requirement were 109.8 and 82.0 ($P = .025$), respectively. The mean number of knee arthroscopies performed in the years before and after the case minimum requirement were 178.6 and 124.8 ($P = .006$), respectively. Residents in the tenth percentile of cases performed still met the required ACGME case minimums each year. The mean total of all cases performed in the years before and after the case minimum requirement were 2045.5 and 1699.3 ($P = .038$), respectively. **Conclusions:** The number of shoulder and knee arthroscopies performed by orthopaedic surgery residents significantly decreased after the implementation of ACGME case minimums, which may be due to underreporting of cases. **Clinical Relevance:** This study may demonstrate the effect of the implementation of the ACGME case minimums on the number of shoulder and knee arthroscopies performed by orthopaedic surgery residents.

The goal of orthopaedic surgery residency is to equip physicians with the knowledge and skills to provide patients with efficient surgical and nonsurgical treatments for musculoskeletal conditions. The Accreditation Council of Graduate Medical Education (ACGME) is the governing body responsible for the accreditation of medical training programs in the United States.¹ With an increased focus on producing

capable physicians, the Resident Case Log System was designed by the ACGME to obtain accurate reporting of procedures performed by residents during their clinical training.¹ It is recommended that residents record performed procedures into the system daily, and program directors are asked to review and monitor these case logs frequently.²

In 2013 the ACGME put in effect a minimum number of cases to be performed, for specific procedures, by orthopaedic surgery residents on completion of residency training.^{3,4} For example, residents must complete and log at least 30 total hip arthroplasties and 10 anterior cruciate ligament reconstructions before completion of residency.³ Jeray and Frick⁵ surveyed postgraduate year (PGY)–4 and PGY-5 orthopaedic residents who attended the American Orthopaedic Association Resident Leadership Forum to obtain their opinion on ACGME surgical case minimums. The authors found that 67% of surveyed residents believed that case logs with minimums were appropriate to gauge surgical experience during orthopaedic residency. On the other hand, Safavi et al.⁶ reviewed the case logs of general surgery residents at 2 programs and

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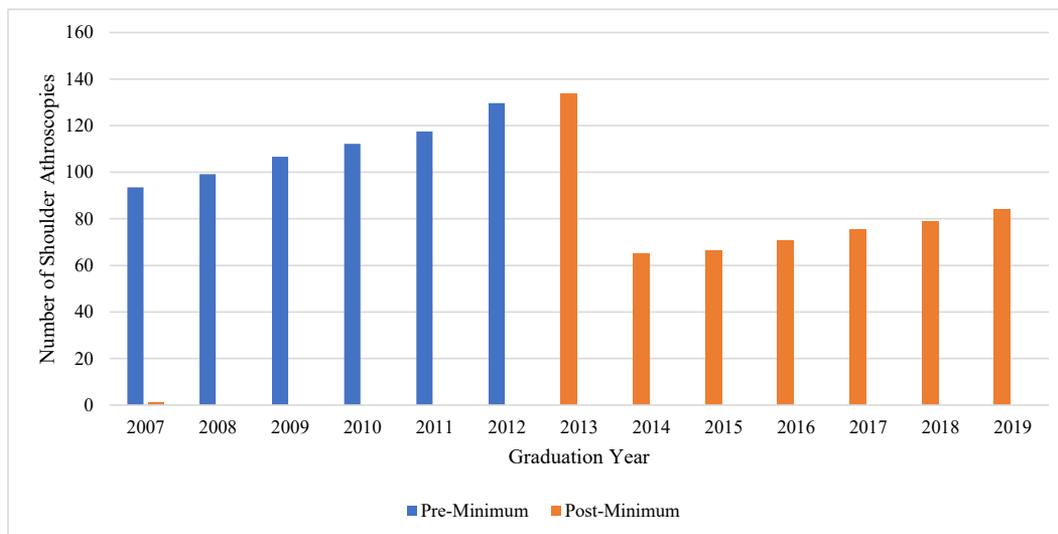


Fig 1. Mean number of shoulder arthroscopies performed per resident.

surveyed recent graduates on procedural competency. The authors found a poor correlation between case volume and self-reported competency ($R = 0.2$).

Arthroscopic procedures are among the most commonly performed orthopaedic surgeries.⁷ However, in 2010, Hall et al.⁸ found that orthopaedic residents lack confidence in performing arthroscopic procedures. Orthopaedic surgery residents at 151 programs were surveyed, and only 32% of PGY-5 residents felt there was enough time devoted to arthroscopic training, and 34% felt as confident with arthroscopic techniques as they did with open procedures.⁸

Previous studies have found that the volume of arthroscopy cases performed by graduating orthopaedic surgery residents has increased from 2007 to 2013.^{9,10} Specifically, the mean number of shoulder arthroscopies increased from 93.5 to 133.8 ($P < .001$) and the number of knee arthroscopies increased from 170.6 to 185 ($P = .011$).¹⁰ Case minimums of 20 shoulder and 30 knee arthroscopies were implemented in 2013 for residents before the completion of residency training.³ The purpose of this study was to examine how the implementation of ACGME case minimums in 2013 has affected the number of shoulder and knee arthroscopies performed by orthopaedic surgery residents during their clinical training. We hypothesized that the implementation of case minimums by the ACGME would result in an increase in the number of shoulder and knee arthroscopies performed by orthopaedic surgery residents.

Methods

The ACGME orthopaedic surgery case log data from the graduation years 2007 to 2019 were accessed from the ACGME website in April 2020.¹¹ The case logs provide data on the number of residency programs and

residents, along with the mean number of total and specific procedures performed per resident upon completion of their training. The median number of specific procedures performed by residents in the tenth, thirtieth, fiftieth, seventieth, and ninetieth percentiles is also included in this data set.

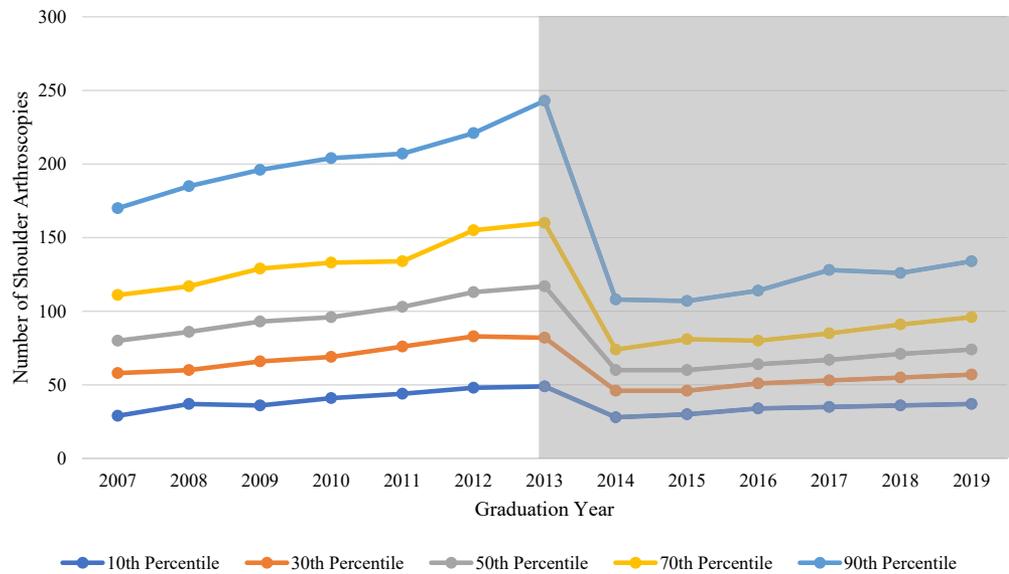
The number of shoulder and knee arthroscopies performed by orthopaedic surgery residents on adult and pediatric patients were analyzed for graduation years 2007 to 2019. Adult and pediatric populations were not separated because the majority of arthroscopies were performed on adults. Shoulder and knee arthroscopies are identified by specific Current Procedural Terminology codes, which count toward the ACGME case minimum requirement. For each graduation year, the mean number of total cases and shoulder and knee arthroscopies performed during residency training was analyzed along with the median number of arthroscopies performed by residents in the tenth, thirtieth, fiftieth, seventieth, and ninetieth percentiles (Figs 1-4).

The data were separated into 2 groups on the basis of the implementation of case minimums by the ACGME: graduation years 2007 to 2012 and 2013 to 2019. These groups were compared using the Student *t*-test, with $P < .05$ considered significant. Percent and fold changes were also presented for the 2 groups. The trends for number of orthopaedic residency programs and residents were analyzed using linear regression modeling.

Results

From graduation years 2007 to 2019, the number of orthopaedic residency programs increased from 149 to 154 ($P < .001$), and the average number of residents per program increased from 4.13 to 4.71 ($P < .001$). There was a significant decrease in the number of

Fig 2. Median number of shoulder arthroscopies performed by residents in the tenth, thirtieth, fiftieth, seventieth, and ninetieth percentiles. Shaded box represents arthroscopies performed after implementation of Accreditation Council of Graduate Medical Education case minimums.



shoulder and knee arthroscopies performed before and after implementation of the ACGME case minimums in 2013 (Table 1, Figs 1 and 3). The average number of shoulder arthroscopies performed in the years before and after the case minimum requirement were 109.8 (range, 93.5-129.7) and 82.0 (range, 65.1-133.8) ($P = .025$), respectively, representing a 25.3% decrease. The average number of knee arthroscopies performed in the years before and after the case minimum requirement were 178.6 (range, 170.6-193.5) and 124.8 (range, 113.3-185.1) ($P = .006$), respectively, representing a 30.1% decrease. The average number of all procedures performed in the years before and after the case minimum requirement were 2,045.5 (range, 1,910.2-2,278.2) and 1,699.3 (range, 1,472.8-2,291.4) ($P =$

.038), respectively, representing a 16.9% decrease (Table 1).

There was a negative trend for the median number of shoulder and knee arthroscopies performed by residents in the tenth, thirtieth, fiftieth, seventieth, and ninetieth percentiles (Figs 2 and 4). Residents in the fiftieth, seventieth, and ninetieth percentiles had larger percent decreases in the number of procedures performed compared to residents in the tenth and thirtieth percentiles. The cases performed for 2013 graduates, the first year the case minimums were implemented, were fairly consistent with previous years. Beginning in 2014, there was a substantial drop in the total number of cases performed along with the number of shoulder and knee arthroscopies performed.

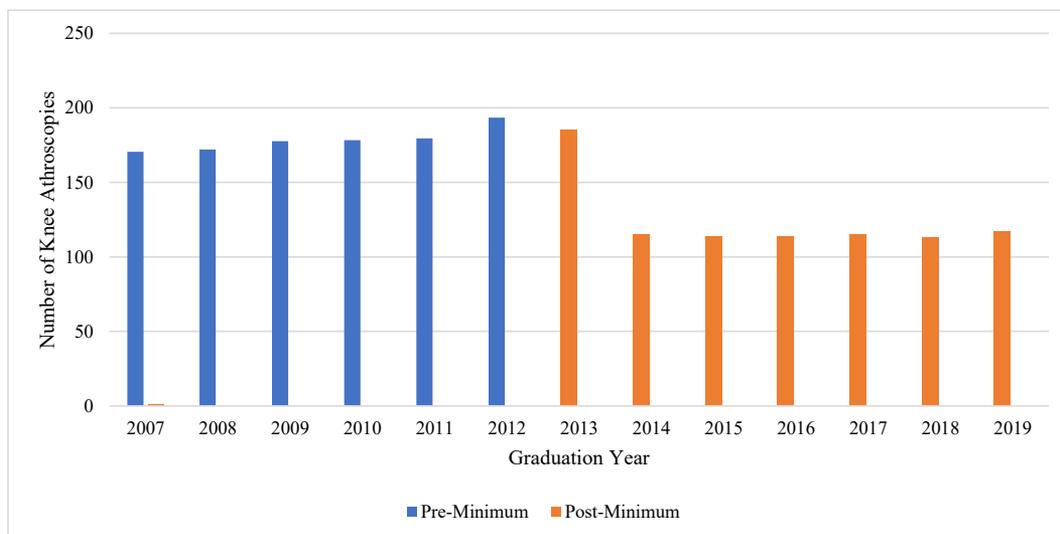


Fig 3. Mean number of knee arthroscopies performed per resident.

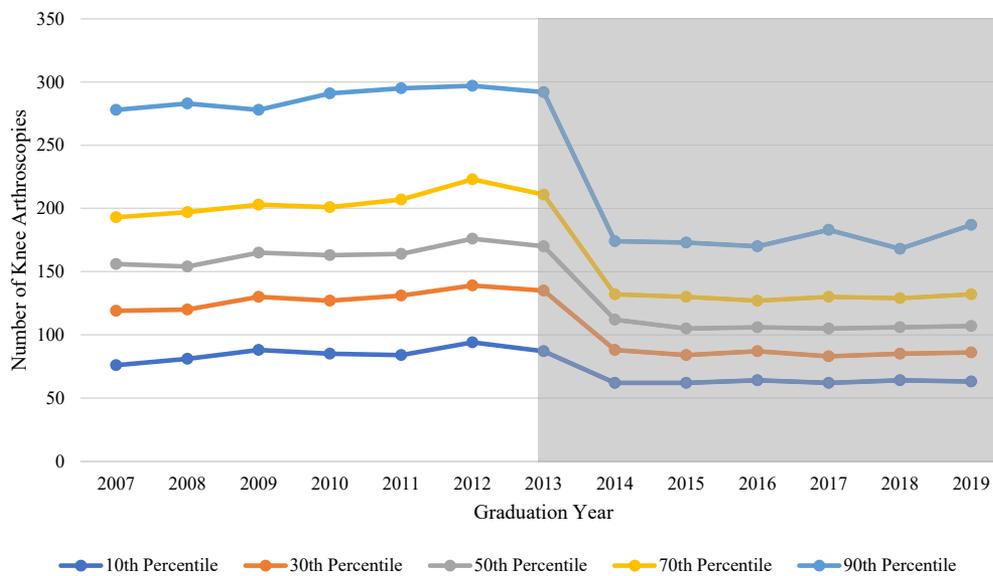


Fig 4. Median number of knee arthroscopies performed by residents in the tenth, thirtieth, fiftieth, seventieth, and ninetieth percentiles. Shaded box represents arthroscopies performed after implementation of Accreditation Council of Graduate Medical Education case minimums.

Discussion

The implementation of case minimums by the ACGME led to a significant decrease in the mean number of shoulder and knee arthroscopies performed by orthopaedic surgery residents. With the number of residents per orthopaedic surgery residency program significantly increasing from 2007 to 2019 ($P < .001$), this may result in less available procedures per resident. However, this is unlikely because the average number of residents increased only by 6.5%, which would not explain the decrease in the number of shoulder and knee arthroscopies by 25.3% and 30.1%, respectively. Surprisingly, the total number of all procedures performed by orthopaedic surgery residents decreased by 16.9% after the implementation of the case minimums. This drastic decline is concerning and may suggest that graduating residents are now performing fewer overall procedures than those residents who graduated before the case minimum implementation.

However, the most likely reason for the significant decrease is due to a lack of reporting by residents into the case log system, because previous studies have demonstrated that residents do not log all cases

performed.^{1,12-15} Specifically, Okike et al.¹² compared the case logs of orthopaedic surgery residents and fellows to the department records at a single institution over a 3-month period. The authors found that orthopaedic surgery residents and fellows failed to log their cases 25% and 23% of the time, respectively. Additionally, when cases were logged by trainees, Current Procedural Terminology codes were missed 46% of the time, and additional codes were added 28% of the time, in comparison to attendings. Naik et al.¹³ compared departmental records of cases performed by PGY-1 general surgery residents to the residents' case logs at a single institution. The authors found that general surgery interns logged an average of 126.3 cases out of the 176.5 performed ($P < .001$). In 2001, Veldenz et al.¹⁵ compared the case logs of PGY-5 vascular surgery residents to departmental records at a single institution. The authors found that the residents underreported aortic reconstructions by 16.7% and cerebrovascular reconstructions by 19.1%.

A combination of the 6.5% increase in the number of residents per program and a 16.9% drop in the total number of cases performed by graduating residents

Table 1. Change in the Average Number of Shoulder and Knee Arthroscopies Performed by Orthopaedic Surgery Residents Before and After Implementation of ACGME Case Minimums

Graduation Year	Shoulder Arthroscopies	Knee Arthroscopies	Total of All Procedures Performed
2007-2012	109.8	178.6	2045.5
2013-2019	82.0	124.8	1699.3*
Percent Decrease	25.3%	30.1%	16.9%
Fold Decrease	1.34	1.43	1.20
<i>P</i> value	0.025	0.006	0.0375

ACGME, Accreditation Council of Graduate Medical Education.

*Data only available from graduation years 2013-2018.

after implementation of the case minimums may explain the 25.3% and 30.1% decrease in shoulder and knee arthroscopies, respectively. However, we do not know the trend in the number of arthroscopies performed at academic medical centers in the United States since the implementation of the case minimums. If the number of arthroscopic procedures performed has increased by greater than or equal to 6.5%, then the increase in the number of residents per program would likely not play a substantial role in the significant drop in the number of shoulder and knee arthroscopies. Thus, even with a probable lack of reporting, current residents may still be performing fewer arthroscopic procedures since the implementation of the case minimums.

The average number of shoulder arthroscopies completed during orthopaedic surgery residency, before and after the implementation of the ACGME case minimums, was 109.8 and 82.0, respectively ($P = .025$). The average number of knee arthroscopies completed during residency training, before and after the implementation of ACGME case minimums, was 178.6 and 124.8, respectively ($P = .006$). These numbers still far exceed the ACGME case minimums of 20 shoulder arthroscopies and 30 knee arthroscopies. In addition, orthopaedic surgery residents in the tenth percentile from graduation years 2007 to 2019 exceeded the minimums. Raising the case minimum requirements may encourage residents to be more diligent about updating their case log to meet the standards set forth by the ACGME and may also give a more accurate assessment of total cases performed in a particular residency program.

Achieving technical proficiency in arthroscopy is challenging and may have a shallower learning curve (i.e., require more cases to attain proficiency) in comparison to other procedures.¹⁶ Thus increasing the case minimums may also enhance arthroscopic education and resident comfort with performing these procedures. In 2010, Hall et al.⁸ found that PGY-5 residents felt less confident in performing certain arthroscopic procedures by themselves such as meniscal repair, rotator cuff repair, lateral release, and Bankart repair. In contrast, Jeray and Frick⁵ performed a recent survey and found that 77% of PGY-4 and PGY-5 residents felt that the case minimum of 20 shoulder arthroscopies was sufficient and should not be increased whereas 80% felt that the case minimum of 30 knee arthroscopies was sufficient and should not be increased.

Other studies have examined the effect of the ACGME case minimums on different orthopaedic procedures. Klimstra et al.⁴ demonstrated a significant increase in the reporting of closed manipulation of forearm and wrist fractures after implementation of case minimums (30.0 to 45.0, $P < .001$). In contrast, Hinds et al.¹⁷ found no significant change in the

number of carpal tunnel release and hand fracture cases performed from graduation years 2007 to 2014 (32.8-28.9, $P = .79$). This suggests that ACGME case minimums may not always have an effect on the number of cases performed or reported. The case minimum for closed manipulation of forearm and wrist fractures is 20, whereas for carpal tunnel release it is 10. In comparison to arthroscopic procedures, these case minimums are much closer to the average number of cases performed or reported by residents, which may be why no significant decrease was seen in the number of cases logged for these procedures.

Logging all cases performed by residents would allow for more objective data analysis and a more accurate reflection of the total number of cases performed. The ACGME may also want to consider requiring a minimum case number for other orthopaedic procedures, such as distal radial fracture fixation and proximal humeral fracture fixation, as residents believe these are a necessity.⁵

Limitations

There are several limitations to this study. The number of cases performed by orthopaedic surgery residents during their 5 years of training was obtained from the ACGME case logs. As mentioned previously, case logs can be inaccurate because prior studies have shown that not all cases performed by residents are logged.¹²⁻¹⁵ However, we are unable to determine if the significant decrease in shoulder and knee arthroscopy cases is due to inaccurate reporting or if residents are spending their time completing other procedures. Additionally, ACGME case log data does not provide information about the extent of resident participation in the procedure. The case logs provide data on the total number of procedures completed by residents at the end of their training, rather than at the end of each year. It would be beneficial to obtain information on the number of cases completed during each year of residency to better understand whether annual resident case volume and logging is consistent from year to year. Finally, we do not have data on the number of arthroscopies being performed throughout the United States each year. This data would allow us to more accurately determine whether the drop in the number of shoulder and knee arthroscopies performed is due to a lack of reporting or a decrease in the total number of these types of cases in the United States.

Conclusions

The number of shoulder and knee arthroscopies performed by orthopaedic surgery residents significantly decreased after the implementation of ACGME case minimums, which may be due to underreporting of cases.

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