

TOPICS IN TRAINING

Operative Experience in an Orthopaedic Surgery Residency Program: The Effect of Work-Hour Restrictions

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Background: The implementation of Section 405 of the New York State Public Health Code and the adoption of similar policies by the Accreditation Council for Graduate Medical Education in 2002 restricted resident work hours to eighty hours per week. The effect of these policies on operative volume in an orthopaedic surgery residency training program is a topic of concern. The purpose of this study was to evaluate the effect of the work-hour restrictions on the operative experiences of residents in a large university-based orthopaedic surgery residency training program in an urban setting.

Methods: We analyzed the operative logs of 109 consecutive orthopaedic surgery residents (postgraduate years 2 through 5) from 2000 through 2006, representing a consecutive interval of years before and after the adoption of the work-hour restrictions.

Results: Following the implementation of the new work-hour policies, there was no significant difference in the operative volume for postgraduate year-2, 3, or 4 residents. However, the average operative volume for a postgraduate year-5 resident increased from 274.8 to 348.4 cases ($p = 0.001$). In addition, on analysis of all residents as two cohorts (before 2002 and after 2002), the operative volume for residents increased by an average of 46.6 cases per year ($p = 0.02$).

Conclusions: On the basis of the findings of this study, concerns over the potential adverse effects of the resident work-hour policies on operative volume for orthopaedic surgery residents appear to be unfounded.

Section 405 of the New York Public Health Code and recent policies of the Accreditation Council for Graduate Medical Education (ACGME) have resulted in the implementation of resident work-hour restrictions^{1,2}. The ACGME work-hour guidelines were implemented in 2002³. These policies restrict the hours worked by residents to eighty hours per week with a maximum of twenty-four hours in one shift. All work shifts require a separation of at least ten hours, and each

resident is required to have at least one twenty-four-hour period of “non-working” time per week.

Much concern has been voiced regarding the operative experience of residents working under the new regulations. The goal of orthopaedic surgery residency training is to educate young physicians and to facilitate the acquisition of a comprehensive fund of knowledge, clinical judgment, operative skills, communication skills, and professionalism to practice orthopaedic

surgery⁴. The amount of operative experience of the residents may impact the acquisition of these skills. As residents increase their operative surgical caseload, their operative decision-making skills and communication with colleagues, patients, and families improve. To date, it remains unknown whether the implementation of work-hour regulations detracts from the crucial operative experiences gained by residents who trained in the era preceding the work-hour policies.

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TABLE I Comparison of Operative Caseload per Resident Year Before and After Implementation of the Work-Hour Restrictions

Year of Training	Before 80-Hour Work Week Restrictions		After 80-Hour Work Week Restrictions		Difference	P Value
	No. of Residents	Caseload*	No. of Residents	Caseload*		
PGY 2 (n = 72)	24	263.3 ± 71.8	48	283.2 ± 106.7	19.9	>0.5
PGY 3 (n = 70)	22	549.8 ± 125.0	48	584.7 ± 159.4	34.9	>0.5
PGY 4 (n = 71)	23	386.7 ± 85.7	48	422.1 ± 97.3	35.4	0.14
PGY 5 (n = 71)	25	274.8 ± 74.7	46	348.4 ± 102.1	73.6	0.001
PGY 2-5 (n = 284)	94	363.6 ± 145.0	190	410.2 ± 163.6	46.6	0.02

*The values are given as the mean and the standard deviation. PGY = postgraduate year.

We conducted a formal review to assess the early effects of work-hour regulations on the operative experience of orthopaedic surgery residents in a large orthopaedic surgery residency training program. Since 2002, the program has been in strict compliance with the Code 405 regulations and resident work hours.

Materials and Methods

We used the operative case logs of the residents of our university-based orthopaedic surgery residency program from 2000 through 2006. Residents at the postgraduate year (PGY)-2 through PGY-5 levels were included for consideration. The PGY-1 residents were not included as their clinical experience is not limited to orthopaedic surgery. Formats for operative case logs were computerized from the ACGME resident case-log system after 2002 and from manual records maintained by the Department of Orthopaedic Surgery prior to 2002. All cases, including closed reductions of fractures, were included. Throughout the time frame of this study, compliance with both case-log recording systems was mandatory for all residents as a requisite for the completion of each postgraduate year and eventual graduation from residency.

From 2000 through 2006, there were no significant changes in the program in regard to required rotations, resident participation in the clinic or office, or the employment of physician extenders. There was no night-

float system in place, and the residents worked within the same call schedule throughout the entire time. The PGY-4 and PGY-5 residents did not take in-house call, the number of junior residents in-house was the same, and the number of hours of in-house call taken by junior residents did not change in any year. The hospital affiliations of the program did not change throughout the time frame of this study and included New York University (NYU) Medical Center, NYU Hospital for Joint Diseases, Bellevue Hospital Center, Jamaica Hospital Medical Center, and the Veterans Administration Medical Center.

After receiving approval from our institutional review board, we administered a formal review of the operative case logs of 109 orthopaedic surgery residents (PGY-2 through PGY-5) during the period from 2000 through 2006. All residents were informed of the purpose of this study and were assured that their records would remain anonymous. Resident anonymity was maintained by blinding the authors to the identities of the resident author of each operative log.

We did not analyze the type of cases performed or the level of participation in each case, as surgical procedure codes were not available in the operative logs prior to the implementation of the ACGME resident case-log system. Operative case volumes were calculated before and after enforcement of resident work-hour restrictions. The statistical analyses

were performed with use of a series of Student t tests.

Results

The operative case logs of 109 orthopaedic surgery residents were included in this study. Prior to the implementation of the work-hour restrictions, the operative experience consisted of a total of ninety-four individual resident years. The data on the operative volume after the adoption of work-rule policies consisted of 190 individual resident years. The average number of operative cases per resident prior to work restrictions was 363.6 per year compared with 410.2 per year following the new work rules (Table I). The mean increase of 46.6 cases per resident work year following the implementation of work-hour restrictions was significant ($p = 0.02$).

Prior to the implementation of the eighty-hour work week, the average number of cases per resident year was 263.3 for PGY-2 residents, 549.8 for PGY-3 residents, 386.7 for PGY-4 residents, and 274.8 for PGY-5 residents. The average number of cases per resident year after the adoption of the new work rules was 283.2 (PGY-2), 584.7 (PGY-3), 422.1 (PGY-4), and 348.1 (PGY-5) (Table I). After the implementation of the new policies, the average increases in cases performed per work year were 19.9 (PGY-2), 34.9 (PGY-3), 35.4 (PGY-4), and 73.6 (PGY-5) (Table I). A comparison of the cases per work year for each level of training showed no significant differ-

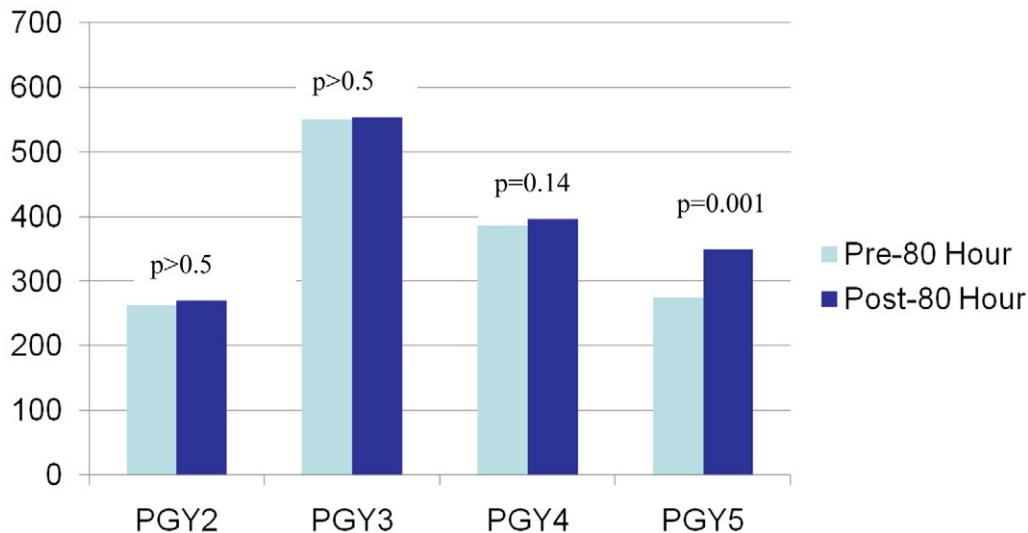


Fig. 1
Average operative caseload per postgraduate year (PGY) of training before and after the implementation of work-hour restrictions.

ence in the number of cases for residents at levels PGY-2 ($p > 0.5$), PGY-3 ($p > 0.5$), and PGY-4 ($p = 0.14$) (Table I, Fig. 1). There was a significant difference in the average number of cases performed per work year by PGY-5 residents ($p = 0.001$) as residents at this level reported a mean increase of 73.6 cases per work year following the implementation of the new work policies (Table I, Fig. 1).

Discussion

Our review was performed to evaluate the impact of work-hour restrictions on total operative case exposure in a large university-based orthopaedic surgery residency program in an urban setting. The collection period included two years prior to and four years following the initiation of strict compliance with the guidelines. The timing of the study was chosen to provide adequate data to evaluate the early impact of work-hour restrictions. In this analysis, we found that the total operative caseload was not negatively impacted by restrictions in work hours.

Residents, in addition to faculty and departmental administrators, are concerned about the potential negative impact of work rules on operative training⁴. Prior analyses have estimated that junior residents lose between

twelve and twenty-four hours of operative experience per week because of the ACGME work rules⁴. However, in our comparison of each individual resident level, no significant change was detected in the number of operative cases performed at the PGY-2, PGY-3, and PGY-4 levels. The PGY-5 residents performed significantly more procedures after the implementation of the work-hour restrictions. Furthermore, on analysis of all residents as two cohorts (before 2002 and after 2002), the surgical volume for the residents significantly increased following the installation of and compliance with the new work rules. Between 2000 and 2006, the operative volume increased by 12.5% across the five hospitals of the residency program, which helped to meet the needs of residency training in the face of work-hour restrictions.

There are several potential explanations for the increase in the operative caseload reported by the PGY-5 residents following the implementation of the work-hour restrictions. Prior to the new regulations, on-call junior residents often stayed to participate in operative cases on days following a night of call-duty. Following the new work rules, these junior residents no longer remained on site. This required the more senior residents to assume

increased operative responsibilities. It can be concluded that, with an increased responsibility in the operating room, the PGY-5 residents had to reallocate their time from other daily responsibilities including clinic coverage as well as personal and study time. Since there were no changes in senior resident coverage of the emergency department, we can deduce that the increase in operative case logs was for surgical procedures and not for closed reductions. Additionally, administrative chief residents and senior faculty members responsible for daily operating-room assignments were forced to maximize resident coverage of cases. The maintenance of operative volumes may reflect a more efficient use of available residents in the operating room, or it may be related to the increased volume across the residency program's hospitals after 2002. Lastly, following the implementation of the new work policies, junior-level residents may have made concerted efforts to compensate for lost time in the hospital by actively seeking to enhance their operative experience. It was likely that a combination of these factors allowed the absolute numbers of case exposures to be maintained for all levels of residents after the implementation of the work-hour restrictions.

Longer-term analysis of operative caseloads may provide further information that will help orthopaedic residency training programs to further adapt to the new policies. This represents the initial longitudinal study to evaluate the effect of the work rules on an important aspect of orthopaedic resident education in one residency program. Further study is required to determine whether the quality of the overall training had been compromised with the implementation of the work-hour restrictions.

The work-hour restrictions have had other positive, measurable effects on residency training programs. Barden et al. showed that residents achieved significant improvement in in-training examination scores with the implementation of the rules set forth by Code 405 ($p < 0.05$)⁵. Similarly, Hassett et al. showed that surgical residents in a university-based training program in an urban setting reported no substantial change in the number of procedures performed and that 90% of the residents were passing the qualifying examinations⁶.

Studies in other surgical specialties have not shown that the eighty-hour work week has compromised operative experience. McElearney et al. showed that the numbers of cases were not significantly different for PGY-1 to PGY-4 residents after work week restrictions had been implemented in a general-surgery residency program⁷. However, the PGY-5 residents reported significantly fewer cases after the work-hour restrictions ($p = 0.03$)⁷. Ferguson et al. showed that work-hour limitations had no effect on case volume⁸.

Similarly, they showed that changes in the daily work schedule to maintain compliance with work-hour restrictions did not affect operative case volume⁸. Our results are in accordance with an earlier report from the University of Oklahoma Health Sciences Center⁹. On the basis of a four-year collection of cases in their orthopaedic surgery residency program, the caseloads of PGY-2 through PGY-5 residents showed no significant difference before and after the implementation of work-hour restrictions⁹.

Most of the studies⁷⁻⁹ in this area evaluated the effects of the work rules on resident attitudes and education, patient care, in-hospital complications, and postoperative outcomes. Many studies were survey-based to evaluate resident attitudes with respect to operative experiences since the adoption of the new policies.

There are inherent limitations in our study. The resident case logs were authored by all residents who participated in the orthopaedic surgery residency program, and self-reporting of case volumes is an obvious weakness. The accuracy of the logs is dependent on the dedication of each resident to document accurately their experience. The different case-log systems, manual before 2002 and electronic after 2002, are also a limitation of the study. A possible explanation for the increased case volume after 2002 may be related to the conversion to an electronic case-log system. The increase in volume throughout the residency program may also confound the results of increasing caseloads after 2002.

To date, concerns over the potential adverse effects of the resident work-hour policies on operative volume for orthopaedic surgery residents appear unfounded on the basis of the findings of our study as well as others⁹. Although the objective of this study was to quantify the differences in operative case volumes, it would be important to analyze the quality of the operative experience following the implementation of the work-hour restrictions. This would require an analysis of the individual components of the residency training program to determine whether there are differences in the types of surgery performed by residents at each level with respect to the implementation of the work-hour restrictions.

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