

Comparative study of the operative experience of surgical residents before and after 80-hour work week restrictions

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Purpose: In Korea, the working-hour limitation regulation has been implemented in December 2017. We aimed to define the difference in operative experience of surgical residents before and after implementing this policy in 2 hospitals among 8 affiliated hospitals of the Catholic Medical Center where implemented the 80 working-hour limitation policy since March 2015.

Methods: All the operation records were reviewed, and the number of resident-participated surgeries between March and August in 2002 and 2017 were compared. Operations performed or participated in by residents as first assistants were defined as resident participated surgery.

Results: After 2 years from the initiation of the resident work-hour limitations, the number of resident participated surgery has slightly decreased in both hospitals (Yeouido St. Mary's Hospital [YSM]: 317 to 302, St. Paul Hospital [SPH]: 635 to 461). For each resident, changes were like followings: 0 → 21 cases for R1, 65 → 72 cases for R2, 83 → 192 cases for R3, and 169 → 17 cases for R4 in YSM. In SPH, number of resident participating surgery was changed like followings: 4 → 32 cases for R1, 222 → 100 cases for R2, 317 → 300 cases for R3, and 92 → 29 cases for R4. In both hospital, while, total number of resident participating oncologic surgery has been decreased, number of resident participating appendectomy has been far increased. Activity of each grade resident is different according to hospital.

Conclusion: Although total number of resident participating surgery decreased, variable changes were observed in each grade of resident according to each type of surgery and different hospitals. It is believed that comparisons of experiences from more hospitals in the future would be helpful in establishing the guidelines for surgical experience requirement of residents in Korea.

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Key Words: General surgery, Time factors

INTRODUCTION

In many countries, working hours of the residents have been changed to reduce the medical mistakes caused by the intense hard work of the residents. In United States (US), the Accreditation Council for Graduate Medical Education (ACGME) mandated the resident work-hour limitations, and these

changes took effect on July 1, 2003. This regulation restricted residents' working hours to no more than 80 hours per week, with individually granted exceptions of up to 88 hours per week [1].

Michigan State University reported that the number of operations participated in by a single resident was significant decreased in 2004 when the 80-hour work limitation was

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followed, than that in 2002 [2]. A retrospective study held in New York State observed no change in operation experience before and after the 80-hour limit took effect [3]. Moreover, they insisted that the system does not affect the quality of resident training because 90% of residents passed the test of the American College of Surgeons. Nevertheless, many studies reported disadvantages of the system due to decreasing experience of major operations and emergency cases.

In US, ACGME and American Board of Surgery clearly defined the minimum requirement for the operative experience during the residency program. A total of 850-hour operator experience for the 5-year residency period and 150-hour supervisor experience are essential to obtain a certificate to take the exam for surgery specialist [4]. For this reason, every training hospital needs to incorporate a training program which can fulfill the minimum requirement.

In 1991, the United Kingdom government introduced an initiative, stipulating a maximum of 72 hours per working week. The first stage of European Working Time Directive requiring junior doctors to reduce their work to a maximum of 58 hours per week, averaged over a 6-month period, became law in August 2004. By 2009 a further reduction to 48 hours per week will be in place [5].

In Korea, the regulation for resident work-hour limitations was created by lawmakers in 2015. It includes not only a recommendation but also a penalty clause. The working hours was adapted from the American criteria. These rules stipulated an 80-hour work week (averaged over 4 weeks): 10 hours off between shifts and 1 day off per week. This regulation will be implemented for all residents from December 2017.

The Department of Surgery in Catholic Medical College adopted this working-hour limitation policy from 2014 in advance. In this study, we aimed to define the difference in operation experience of surgical residents before and after applying this policy from 2 hospitals among eight affiliated hospitals of Catholic Medical Center. From this study, we can find the indirect influence of the resident work-hour limitations on the experience of surgical residents in Korea.

METHODS

We evaluated the surgical volume of general surgical services in 2 affiliated hospitals since the implementation of duty-hour restrictions and compared this volume with that of the previous time without these duty limits. We defined resident-participated surgery as an operation in which the resident performed under supervision or participated in as a first assistant.

All operation records and the number of resident-participated surgeries between March 2002 and August 2002, when the 80-work hour regulation was not yet implemented, were reviewed. The number of operations was also counted from March and

August 2017. All operations were classified according to the organ involved. A comparative study regarding the number and type of operations was planned between the number of surgeries between 2002 and 2017.

Comparisons were made between the control and comparison groups in the 13 categories (upper gastrointestinal, lower gastrointestinal, proctology, liver, breast, thyroid, vascular, pediatric, appendectomy, hernia, cholecystectomy, soft tissue, and miscellaneous). The Institutional Review Board of The Catholic University of Korea, College of Medicine, approved the study protocol (approval number: XC17REDI0061).

All case numbers were determined and compared between both groups.

All data were described presented regarding the number of resident participating surgery. To reveal the difference of experience according to resident grade, Fisher exact test was done with IBM SPSS ver. 18.0 (IBM Co., Armonk, NY, USA).

RESULTS

From March to August 2002, 1,115 general surgeries were performed at YSM. Among these, residents participated in 700 surgeries (62.8%). In that time, there was 1 first-grade resident (R1), 3 second-grade residents (R2), 2 third-grade residents (R3), and 2 fourth-grade residents (R4) in YSM. The number of resident participating surgery by one resident of each grade were 0 case in R1, 65 cases in R2, 83 cases in R3, and 169 cases in R4 (total, 317 cases) (Table 1). In SPH, there was only one resident per grade during the same period. The number of resident participated surgery was 4 for R1, 222 for R2, 317 for R3, and 92 for R4 (Fig. 1). Trend in number of resident participating surgery significantly differ in both hospitals.

After 2 years from the initiation of the resident working-hour limitation, the number of resident participating surgery has slightly decreased in both hospitals. In YSM, the total number of resident participating surgery decreased from 317 to 302. In YSM, for each resident, there were 21 cases for R1, 72 cases for R2, 192 cases for R3, and 17 cases for R4 in 2017. In this period, a total of 903 general surgeries were performed. In SPH, a total of 657 and 644 operations were performed in 2002 and 2017, respectively. Among these, the number of resident participating surgery were 635 (96.7%) and 461 (71.6%) in 2002 and 2017, respectively. For each grade of resident, there were 32 cases for R1, 100 cases for R2, 300 cases for R3, and 29 cases for R4. In 2002, there were no surgical assistants (SAs) in either hospital. However, 2 and 1 SA worked in YSM and SPH, respectively, in 2017. The specific types of resident-participated operations are presented in Tables 2 and 3. Compared to 2002, the number of resident-participated oncologic surgeries has decreased in YSM. Especially, participation in gastric and breast cancer surgeries has dramatically decreased. Otherwise, participation

Table 1. Total number of residents who participated in the surgery has been changed

Hospital	Year	R1	R2	R3	R4	R-total	P-value	Total
SPH	2002	4	222	317	92	635	<0.001	657
	2017	32	100	300	29	461		644
YSM	2002	0	196	166	338	700	<0.001	1115
	2002*	0	65	83	169	317		
	2017	21	72	192	17	302		903

R1, first-grade resident; R2, second-grade residents; R3, third-grade residents; R4, fourth-grade residents; R-total, resident-participated surgery; SPH, St. Paul Hospital; YSM, Yeouido St. Mary's Hospital.

*Modified number per one resident in each grade.

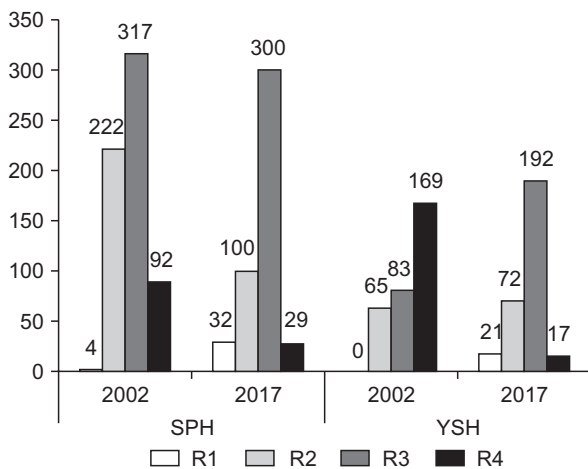


Fig. 1. Changing number of operations performed or primarily assisted by residents (Modified as the number per resident). SPH, St. Paul Hospital; YSM, Yeouido St. Mary's Hospital; R1, first-grade resident; R2, second-grade residents; R3, third-grade residents; R4, fourth-grade residents.

in colorectal malignancy surgeries increased slightly, and participation in laparoscopic appendectomy surgeries far increased. In SPH, participation in gastric cancer surgeries decreased, while participation in colorectal malignancy surgeries increased. Participation in other types of surgeries showed a slight increase or decrease according to each type.

In SPH, R3 participated most actively both in 2002 and 2017. In YSM, R4 and R3 participated in more surgeries than other residents in 2002 and 2017, respectively. Both in YSM and SPH, the number of operations participated in by R4 decreased significantly (SPH, 92 to 29; YSM, 169 to 17).

DISCUSSION

Modern society represents an era marked by the demand for qualitative improvement over quantitative increase. As quality of life and human rights has become more important, social demand for working hours has become inevitable for any group, which also applies to the hospital society. With no limit on working hours, it has gone from an era of learning

medicine through apprenticeship education to learning by a well-designed educational program. This is even more difficult as it must be conducted within limited working hours. In many Western countries, the system of limited weekly working hours for patient safety and reduction of work intensity of residents has been implemented, together with social discussions, since, several decades ago and with decreased training time, the definition and fostering of alternative personnel and competency-based education have been implemented and conducted as a training program for interns and residents [6]. Unlike Western countries, Korea implemented a system of limiting working hours to 80 in 2017, with a short social discussion period, and as a result, such system is being carried out under a pattern different from other countries.

Even in United States, where the resident work-hour limitations on training period has been implemented for over 14 years, there are ongoing questions regarding the surgical competencies of residents. Without the time spent in the hospital and operating room, it has been questioned whether general surgery residents would be adequately prepared for independent practice [7].

Those changes have become a true burden for all the training hospitals in Korea, because residents were regarded as a labor force rather than trainees so far. Most surgical residents were willing to endure laborious working hours more than 100 hours in a week. They can learn procedures from their senior or trainer by only helping on real clinical scenarios. Although hospitals are putting forth much effort to meet the conditions of limited training period, most are bare complying with the working-hour requirements, while still failing to substantiate resident training. In Korea, sufficient surgical experience for residents has not been systematically regulated, but it was assumed that they had acquired sufficient surgical experience from each training institution. However, working-hour limitation has made it difficult for such tacit agreement to coexist, creating a situation where systematic support must be provided from academic societies. From an educator's perspective, it is suspected to result in insufficient surgical experience than before which would be directly linked to

Table 2. Number of operations in which the resident participated as operator or first assistant in St. Paul Hospital

Type of operation	R1		R2		R3		R4		Total	
	2002	2017	2002	2017	2002	2017	2002	2017	2002	2017
Stomach										
Cancer	0	0	0	0	4	8	16	0	20	8
Benign	0	1	0	2	0	5	1	1	1	9
Small bowel	0	2	1	1	15	14	3	3	19	20
Colorectal										
Cancer	0	0	0	1	14	21	5	3	19	25
Benign	0	0	3	2	2	6	5	3	10	11
Anus	0	0	12	3	13	6	6	0	31	9
Hepatobiliary										
Hepatectomy	0	0	0	0	0	3	1	0	1	3
Pancreatectomy	0	0	0	0	0	0	0	0	0	0
Whipple's	0	0	0	0	0	1	1	0	1	1
CBD stone	0	0	1	0	6	0	1	0	8	0
Breast										
Cancer	0	0	5	4	8	8	1	1	14	13
Benign	0	1	28	5	6	3	1	0	35	9
Thyroid										
Total	0	0	0	1	4	5	1	2	5	8
Lobectomy	0	0	0	1	8	4	0	0	8	5
Vascular										
Chemoport	0	1	5	5	5	17	0	3	10	26
AVF	0	0	6	5	2	5	0	2	8	12
Others	0	2	17	4	17	14	3	1	37	21
Pediatric										
Hernia	0	0	10	0	12	0	0	1	22	1
Others	0	0	0	0	1	0	0	0	1	0
Appendectomy										
Laparoscopic	0	19	0	17	0	60	0	4	0	100
Open	1	0	71	0	94	1	17	0	183	1
Hernia (adult)	0	0	12	8	30	28	7	2	49	38
Cholecystectomy										
Laparoscopic	0	2	1	20	24	48	10	3	35	73
Open	0	0	2	0	5	1	6	0	13	1
Soft tissue										
Excision	1	3	28	17	25	27	2	0	56	47
I&D	2	1	10	1	14	6	0	0	26	8
Miscellaneous	0	0	10	3	8	9	5	0	23	12
Total	4	32	222	100	317	300	92	29	635	461

R1, first-grade resident; R2, second-grade residents; R3, third-grade residents; R4, fourth-grade residents; CBD, common bile duct; AVF, arteriovenous fistular; I&D, incision and drainage.

qualitative decline in surgical residents.

Although mandated duty hours have been in effect for more than a year, no data exist to answer a practical question in curriculum redesign.

The Korean Surgical Society defines 60 cases within 4 years as the minimum requirement of residents participating in surgery as the first assistant or surgeon during their 4-year surgical residency period (based on reference literature on the homepage of Korean Surgical Society). This does not include central venous catheterization, which has different standards

from other countries, and compared to the US, this would be equivalent to having no minimum standard. Moreover, the standard in the US requires submission of all surgical records to the society, whereas in Korea, only the records from the minimum number of surgeries participated in are submitted, which makes it impossible to confirm the overall surgical experience and determine the differences between institutions. This is also the reason why each training institution cannot let the applicants for residency know how they may be able to gain such surgical experience.

Table 3. Number of operations in which the resident participated as operator or first assistant in Yeouido St. Mary's Hospital

Type of operation	R1		R2		R3		R4		Total	
	2002	2017	2002	2017	2002	2017	2002	2017	2002	2017
Stomach										
Cancer	0	0	0.3	9	1	6	35	0	36.3	15
Benign	0	0	0.3	4	1.5	4	3	0	4.8	8
Small bowel	0	0	0	1	1	2	0.5	0	1.5	3
Colorectal										
Cancer	0	1	0.3	4	11.5	17	4	5	15.8	27
Benign	0	0	0.3	5	4.5	10	2.5	0	7.3	15
Anus	0	1	1.7	3	6	1	3	2	10.7	7
Hepatobiliary										
Hepatectomy	0	0	0	3	0	3	0	1	0	7
Pancreatectomy	0	0	0	1	0	5	0	0	0	6
Whipple's	0	0	0	0	0	1	0	0	0	1
CBD stone	0	0	0.3	0	0.5	3	0.5	0	1.3	3
Breast										
Cancer	0	1	0	2	1	3	24	0	25	6
Benign	0	2	2	4	2.5	3	43	0	47.5	9
Thyroid										
Total	0	0	0	0	1	0	11	0	12	0
Lobectomy	0	0	0	4	0	0	11	0	11	4
Vascular										
Chemoport	0	3	24.3	1	3.5	20	5	4	32.8	28
AVF	0	0	7	4	3.5	2	0	0	10.5	6
Others	0	4	5	4	1	12	1	0	7	20
Pediatric										
Hernia	0	0	1	0	0	1	0	0	1	1
Others	0	0	2	1	1	2	0.5	0	3.5	3
Appendectomy										
Laparoscopic	0	8	13	10	16	76	2.5	2	31.5	96
Open	0	0	1	0	7	0	1	0	9	0
Hernia (adult)	0	0	0.7	2	0.5	2	0	2	1.2	6
Cholecystectomy										
Laparoscopic	0	0	1.3	3	5	5	2	0	8.3	8
Open	0	0	0	0	0	0	1	0	1	0
Soft tissue										
Excision	0	0	3.7	5	8.5	8	15.5	0	27.7	13
I&D	0	1	0.7	1	3.5	3	1	1	5.2	6
Miscellaneous	0	0	0.3	1	3	3	2	0	5.3	4
Total	0	21	65.3	72	83	192	169	17	317.3	302

R1, first-grade resident; R2, second-grade residents; R3, third-grade residents; R4, fourth-grade residents; CBD, common bile duct; AVF, arteriovenous fistular; I&D, incision and drainage.

The results in this study showed that the number of surgeries that residents from 2 hospitals participated in partially decreased after the 80-hour training limitation was implemented, but the differences were not very large. The more important fact is that changes in the type of surgeries occurred more so that the total number of surgeries participated in were different depending on the hospital situation. Bland et al. [8] in

2005 compared the average total major procedures performed by chief residents in 1997–2001 and those in 2003 and reported no significant difference in the overall surgical experience for major procedures, and therefore, there was no negative impact on chief resident operative experience during the first year after restriction implementation. Carlin et al. [9] published a study comparing 2001–2003 operative volume with 2003–

2005 operative volume and found a significant decrease in postgraduate 1st year, postgraduate 2nd year, and postgraduate 4th year total and primary surgeon operative volume in their program. Damadi et al. [2] compared the resident operative experience for 2000–2002 with that of 2003–2005 and found an overall decrease in operative volume in both chief and nonchief year cases. Watson et al. [10] reported that despite an increase in the total number of major operative cases available, the volume of surgeries performed by residents has decreased after the implementation of working-hour restrictions. In the US, where an 80-hour work limitation was implemented in 2003, there are still varying opinions on how surgical experience has been affected by this limitation.

The results of this study showed that the pattern of change in the number of surgeries participated in by residents as the first assistant or surgeon appeared differently between the 2 hospitals. In SPH, the percentage of surgeries participated in by residents as the first assistant or surgeon decreased from 96.7% in the first half of 2002 to 71.6% in the first half of 2017. This is because SPH has SAs working in the operation room in 2017, and as such, they acted as the first assistant in numerous laparoscopic surgeries. At both time points, R3 gained the most surgical experience, while surgical experience of R2 tended to decrease (222→100). The type of surgery that showed the biggest decrease was appendectomy. The biggest reason for this is that, in the past, residents generally gained certain level of proficiency in open appendectomy during their first-year program and advanced to second year to complete their surgical experience by the first half, whereas with transition to laparoscopic appendectomy, the environment has become difficult to gain the necessary proficiency within the first year. This is also confirmed by the fact that laparoscopic appendectomy is the surgery that showed the highest increase among surgeries by R3. This is similar to the findings by Mullen et al. [11], reporting that, along with the proliferation of laparoscopy for common general surgical procedures, there has been a concomitant reduction in the participation of junior-level residents. With respect to surgical experience at both time points, it was confirmed that the R3 were most active. In the past, the first half of the first year was considered as the period for becoming familiar with patient care in the wards, and thus, it was rare to participate in surgeries as a surgeon except as the first assistant. However, results from 2017 showed that there was an increase in the number of participation in laparoscopic appendectomy as the first assistant or higher. It is believed that this is because R1 are called into the operating room more often since it became impossible to have many staff on duty due to working-hour limitation.

Other workforce members can influence the number of resident participating surgery. In YSM, there was 1 fellow in 2002, but no fellow in 2017. There was no SA in 2002, but 2 SAs

working in 2017. In 2002, residents participated in 62.8% (700 of 1105) of all surgeries as the first assistant or higher, whereas in 2017, residents participated in only 33.4% (302 of 903) of surgeries as the first assistant or higher. The main reason for this was that the number of residents decreased from 8 to 4, while the next main reason was only 2 SAs were working. Considering decreased number of total operation, we cannot sure the number of resident participating surgery according to adjusted number (317 in 2002 to 302 in 2017) changed in YSM. In case of SPH, there was no fellow surgeon in both period, but SA started to work with since 2015. Existence of SA might influence decreased proportion of resident participating surgery in SPH. However, we can also say that SA helped to fulfill the 80-working hour limitation by decreasing the burden of residents.

The surgical experience of R3 showed a large increase (83→192), but since such increase mostly involved laparoscopic appendectomy, the reason behind such increase is believed to be the same as SPH.

In our results, the surgical participation rate of R4 showed noticeable decrease from 2002 to 2017. Participation rate in surgery was low because this was the period that is a part of the selective training program for R4 that include endoscopy and ultrasound that were implemented from 2015 in our institution.

Surgical experience of residents is affected by not only the resident work-hour limitations but other various factors as well. Compared to 2002, the field of surgery in Korea has undergone various changes in 2017. The resident quota gradually decreased, but hospitals became bigger in size. Due to the phenomenon of residents being reluctant to volunteer for challenging divisions, the number of resident volunteers has decreased, to the point where only 80% of the nationwide quota is being filled, which has increased the work intensity of individual residents. Moreover, the implementation of the subdivision system within the surgery division created a change in training environment where residents have to work while being affiliated with one subdivision for each period. Such change has also affected the personnel structure of hospitals, creating a situation where a physician assistant (PA) must be on duty. Residents who work on regular shifts are less helpful than PAs with respect to surgical flow in major oncology surgery, and as a result, staff surgeons may have a higher preference for PAs or SAs than residents. It is believed that the level of participation in major cancer operations by residents was lower in 2017 than that in 2002 in our study because of such reasons.

In addition, the surgical method also has an impact on changes. With rapid advances in minimally invasive surgeries, such as laparoscopic surgery, the number of opportunities for residents to participate in surgery has decreased, but such opportunities have increased in some other surgeries, such as appendectomy. However, with major operations, such as

cancer surgery, transitioning to minimally invasive surgery, the number of opportunities for residents to participate in surgery has tended to decrease [12]. Some studies in the US reported a pattern of decrease in the surgical experience of junior residents, while the surgical experience of chief residents was unaffected or actually increased [11,13,14]. However, a direct comparison with Korea is difficult since the minimum number of surgeries reported in the US was much higher than that of Korea.

There were some limitations of this study. Because of the study design, data were retrospectively surveyed, relying on handwritten surgery logs. Moreover, there was no clear way to distinguish whether the role of the resident was a first assistant or surgeon in the operating room. This is because of the common practice of writing down the role of the resident as the first assistant, even if he or she actually participated as a surgeon. To derive more reliable study results, information gathered from the residents themselves personally recording whether they participated in as a first assistant or surgeon is needed, and such practice should be encouraged in the medical society. Another limitation is that our study included only relatively small volume hospitals which cannot reflect

the nationwide status of resident training. There were various changes in total amount of resident quota in Korean Surgical Society and hospital volumes. To reflect current training environment, more large scale multicenter study should be done.

In conclusion, although total number of resident participating surgery decreased, variable changes were observed in each grade of resident according to each type of surgery and different hospitals. It is believed that comparisons of experiences from more hospitals in the future would be helpful in establishing the guidelines for surgical experience requirement of residents in Korea.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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