

Systematic Review

Impact of residents' involvement in urological surgeries: a systematic review

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ABSTRACT

Many investigations have reported the impact of resident involvement in urological surgeries. We aimed to conduct this systematic review to create enough evidence regarding this impact based on the outcomes obtained from the relevant studies. We have performed both manual and electronic search through many databases like Google Scholar, Web of science, PubMed, Scopus, Cochrane library, the international standard randomised controlled trial number registry, and the world health organization virtual health library to obtain all the relevant citations. Our intended outcomes included the risk of developing complications, operative time, and rate of reoperations. We have included 17 studies that reported the impact of residents' involvement in urological surgical operations. While some studies reported some complications, the risk of developing complications was not significantly associated with residents' involvement according to most studies. Only one study reported that complications were significantly associated with residents' involvement. The rate of reoperation and readmission after the primary surgery was also non-significant. On the other hand, most of the included studies showed that residents' involvement was significantly associated with increased hospital stay and prolonged operative time. Our results indicate the residents' involvement does not impact the overall safety of the urological procedures and that this practice should be encouraged with adequate supervision.

Keywords: Urology, Residents, Impact, Involvement, Surgery

INTRODUCTION

Residents or doctors-in-training might face various challenges during the residency period which requires their integration in many surgical procedures that usually require various technical skills that these physicians might lack. Although many approaches have been proposed to teach surgical skills to residents, a hands-on approach would remain the most accurate way for better

acquisition of the required skills. However, involving in these practices is essential to get enough experience with preservations regarding the minimum provided quality of care. Moreover, previous studies have demonstrated the employment of the graduated responsibility concept among these residents.^{1,2} It is essential to stress the need to provide acceptable rates of the provided care regarding patients' outcomes and satisfaction, which serves the residents, the patient, and the healthcare system.

This would imply the increased need for supervision and working hours.³

Although the accreditation council for graduate medical education previously announced that residents or trainees within surgical departments are obliged to attend a specified number of surgical procedures to graduate, previous studies showed that the quantitative participation does not fulfill the required efficiency for these residents.^{4,6} Moreover, training under supervision within the residency period to attain the required competence and skills is certainly better than performing without the needed experience and supervision. As a result of such issues, many concerns have aroused regarding the quality of these procedures and the quality of provided care.^{7,8} Consequently, many investigations have been previously published to encourage residency training on surgical procedures in many departments.^{9,10} Within urological surgeries, investigations have shown that residents' involvement was associated with a similar number of complications to senior urologists. However, the operative time was significantly prolonged among resident doctors.⁸⁻¹²

There are many obstacles to be considered for the assessment of such involvement approaches. The challenges of the applied surgical techniques within the operations might add to the pre-existing burdens on the trainees due to the increasing technological advances which usually require the integration of fine skills. For instance, urology oncological procedures usually require minimally-invasive techniques.^{13,14} Operating open surgeries might also differ from surgeries with laparoscopic or robot-assessed techniques. However, investigations show that the outcomes for residents were similar to those obtained with senior surgeons.^{15,16} No previous systematic reviews have been published in this area. Consequently, we aimed to conduct this study to create enough evidence regarding the impact of residents' involvement in urological surgical procedures based on the outcomes obtained from the relevant studies.

METHODS

Study population and inclusion criteria

We conducted this systematic review to investigate the impact of residents' involvement in urological surgeries. Our outcomes included the clinically reported outcomes only, as the occurrence of complications and safety of patients, length of operational time and hospital stay, and rate of reoperations. Consequently, we have put strict criteria to include all the relevant studies and exclude all the irrelevant ones. Our inclusion criteria included 1) original studies, 2) reported the outcomes following a urological surgery by a resident, 3) human studies, 4) investigated any of the mentioned outcomes. On the other hand, we excluded articles if they 1) were not original, 2) was not done in the urological surgery department, was done in the urology department, but in combination with

other departments (as pelvic prolapse or sacrocolpopexy, hernia, vaginal hysterectomy, and others), did not investigate the parameters of safety and efficacy related to the procedures as determined in our outcomes, or assistance was done, including robot-assessed surgeries, 3) investigated non-human subjects, 4) were incomplete or irrelevant outcomes, 5) were a thesis, protocol, letter, editorial, with non-available full-text. We prefer not to involve residents where assistance was introduced to assess the real efficacy of residents. For instance, studies have reported that supervision might reduce the rates of complications, while other studies have reported that robotic surgeries, which are usually big procedures, increased the operative time of the procedures, which, therefore, might bias the investigated outcomes, and therefore, such studies were excluded.^{17,18,20}

Search strategy

Based on these criteria, we have extracted the relevant common key-words to retrieve all the relevant articles that can help us formulate the current literature. We have also used the MeSH database to attain all the possibly relevant words. The keywords included: resident, trainee, doctor-in-training, urology, urological surgery, urethral, urethroplasty, prostatectomy, and nephrectomy. Finally, these words were then formulated into a structured strategy that included all of them using the necessary boolean operators based on each searched database guidelines. These databases included Google Scholar, web of science, PubMed, Scopus, Cochrane Library, the international standard randomised controlled trial number registry, and world health organization virtual health library. In addition to this electronic-based approach, we searched the references of the included studies and relevant reviews to include all the articles that were potentially missed by the main electronic strategy. In all of these steps and the following ones, we followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines.²¹

Screening, data extraction

Following the thorough search strategy that we conducted, both electronically and manually, we created an endnote library, to which we have retrieved all the search results to detect all the duplicates. In the following steps, we used our criteria to screen the remaining references which were grouped into a unified sheet, in order not to miss any articles and to make the process easy on members. Each members' screening and extraction results were blinded to miss any bias regarding the study selection and to properly include all the relevant studies only. We conducted two approaches to screening. These include the title and abstract screening followed by full-text screening. After agreement on the selected articles, two members volunteered to design a suitable extraction sheet to collect the relevant information from the included studies. These were 1) baseline characteristics as study design, reference, gender, title,

year, country, and last name of the first author, 2) outcomes as the length of operation, complications, overall efficacy, length of hospital stay, and reoperation or readmission, 3) risk of bias assessment.

Assessment of bias

This was the last step of the extraction sheet and was done using the adjusted Newcastle-Ottawa scale (NOS) for cross-sectional studies was used.²² The tool included three main domains including methodological quality, compatibility, and outcomes. According to the grading system of the tool (0-10), all studies were to be marked as non-satisfactory (0-4), satisfactory (5-6), good (7-8), and excellent (9-10) based on their degree of assessed bias.

Included studies

After the online database searching of the aforementioned databases, we identified 5474 citations that could be relevant to our aimed outcomes. Another two citations were also identified by the process of manual search and were added to the combined endnote library to exclude all the duplicates. Title and abstract screening were done for 1920 citations, by which we identified 197 articles for full-text screening. Finally, we included 17 articles. These were done according to our previously discussed inclusion and exclusion criteria and our announced outcomes. The detailed information of the search strategy can be seen in Figure 1.

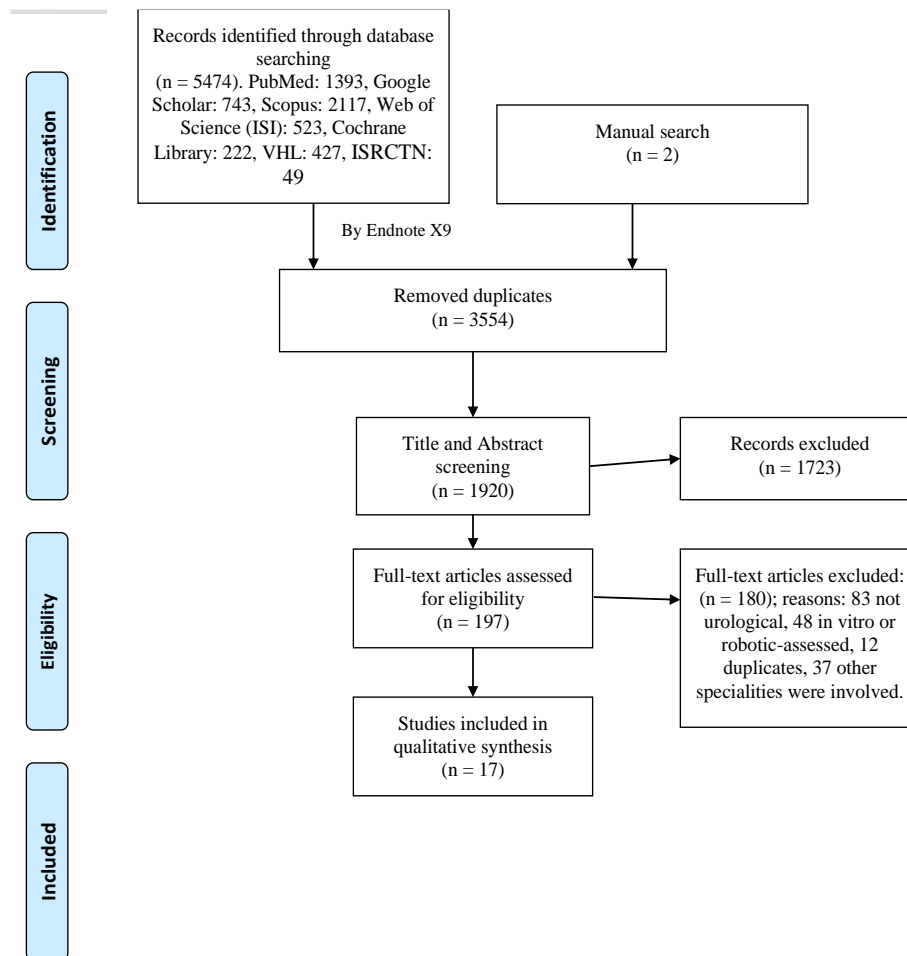


Figure 1: The flow chart for search strategy, including selected studies identification process.

RESULTS

Assessed risk of bias

According to the NOS scale, most of the included studies were marked good while the rest of them were satisfactory with only one marked excellent. This means that the included studies did not have a significant bias. Bias per assessed domains was variable for each one and not one of the domains showed the highest risk of bias across the different studies. The detailed assessment and grading of all the included studies can be seen in Table 1.

Baseline characteristics

We have finally included 17 studies that were conducted between 2005 and 2020. Most of the studies were conducted from data within the United States, which is attributable to the involvement of the national surgical quality improvement program's (NSQIP) as most studies depended on the retrospective data collection from this database. The total number of patients is 110,690 with huge variability between the included studies. Other baseline characteristics and a summary of the outcomes are presented in Table 2.

Table 1: Risk of bias assessment of the included studies using the modified modified Newcastle-Ottawa quality assessment scale.

Author	Year	Selection				Comparability	Outcome		Total score	Quality
		Representativeness of the sample	Sample size	Non-Respondents	Ascertainment of the Exposure	The Subjects in Different Outcome Groups are Comparable	Assessment of outcome	Statistical analysis		
Aisen et al	2018	+	+		+	+	+	+	6	Satisfactory
Allard et al	2015	+	+	+	+	++	+	+	8	Good
Del Rosso et al	2013	+	+	+	+	++	+	+	8	Good
Herrick et al	2013	+	+	+	+	+	+	+	7	Good
Holland et al	2019	+	+		+	+	+	+	6	Satisfactory
Kara et al	2018	+	+	+		+	+	+	6	Satisfactory
Kern et al	2014	+	+	+	++	+	+	+	8	Good
Ku et al	2008	+	+	+	+	+	+		6	Satisfactory
Loppenberg et al	2016	+	+	+	+	++	+	+	8	Good
Matulewicz et al	2014	+	+	+	++	++	+	+	9	Excellent
Meyer et al	2015	+	+	+	+	+	+	+	7	Good
Nguyen et al	2008	+	+		+	+	+		5	Satisfactory
Nieder et al	2005	+		+	+		+	+	5	Satisfactory
Prive et al	2019	+	+	+	+	++	+	+	8	Good
Roghmann et al	2013	+	+	+	+	+	+	+	7	Good
Vetterlein et al	2016	+	+		+	++	+	+	7	Good
Yip et al	2020	+	+	+	+	++	+	+	8	Good

Table 2: A summary of the baseline characteristics and outcomes of the included studies.

Reference	Year	Country	Study design	Data collection	Sample size	Male (n)	Mean age (SD)	Outcomes		
								Complications	Operative time	Re-operation
Aisen et al ³³	2018	United States	Cross-sectional	Retrospective	29,488	-	-	Increased	Longer	NS
Allard et al ²⁸	2015	United States	Cross-sectional	Retrospective	8152	5093		NS	Longer	NS
Del Rosso et al ²⁹	2013	Italy	Cross-sectional	Prospective	80	80	66.3 (51-78)	Ns	NS	NS
Herrick et al ³⁰	2013	Lebanon	Cross-sectional	Prospective	79	79	64.6 (9.3)	NS	Longer	NS
Holland et al ³²	2019	United States	Cross-sectional	Retrospective	3316	-	-	NS	Longer	Lower
Kara et al	2018	United States	Cross-sectional	Prospective	309	309	64.2	NS	NS	NS
Kern et al ³⁴	2014	United States	Cross-sectional	Retrospective	1251	752	-	NS	Longer	NS
Ku et al ³¹	2008	United States	Cross-sectional	Retrospective	5,070	5,070	60.7 (6.6)	NS	Longer	NS
Loppenberg et al ³⁵	2016	United States	Cross-sectional	Retrospective	1,378	-	58 (48-68)	NS	Longer	NS
Matulewicz et al ²³	2014	United States	Cross-sectional	Retrospective	40,000	31,031	64	NS	Longer	Lower
Meyer et al ²⁴	2015	United States	Cross-sectional	Retrospective	235	235	51 (43-66)	NS	Longer	NS
Nguyen et al ³⁶	2008	United States	Cross-sectional	Prospective	267	267	39.1 (6.4)	NS*	NS	NS
Nieder et al ³⁷	2005	United States	Cross-sectional	Prospective	173	-	67	Decreased	NS	NS
Prive et al ²⁷	2019	Netherlands	Cross-sectional	Retrospective	229	229	-	NS	Longer	NS
Roghmann et al ¹⁷	2013	United States	Cross-sectional	Retrospective	19462	-	-	NS	NS	NS
Vetterlein et al ²⁵	2016	United States	Cross-sectional	Retrospective	267	267	37 (27-46)	NS	Longer	NS
Yip et al ²⁶	2020	United States	Cross-sectional	Retrospective	934	934	48 (17)	NS	Longer	NS

NS: non-significant or was not estimated. All outcomes were investigated for a possible risk-association with residents' involvement. *assessed the visual pain score (VAS).

DISCUSSION

In the present study, we aimed to elaborate on the impact of residents' involvement in urological surgeries as assessed by clinical variables including risk of occurrence of complications, the operative time, and the risk of re-occurrence from investigations that previously compared between residents and non-resident populations.

The risk to develop complications

This outcome was extensively reported in our study and is considered the hallmark for assessment of the overall safety of patients and the quality of provided care. In 2014, a large cohort study by Matulewicz et al.²³ included 40,000 patients from the 2005-2011 NSQIP that were divided into patients that underwent urological surgeries by residents and non-residents doctors. The authors reported that the occurrence of overall complications was not significantly associated with residents. However, some complications were significantly associated with this population as surgical complications, the occurrence of sepsis, and septic shock. However, the authors reported that the presence of residents was associated with decreased risk of developing complications and overall mortality. Based on the NSQIP data also, Meyer et al, Vetterlein et al and Yip et al investigated similar outcomes in patients that underwent one-stage anterior urethroplasties, orchiectomy, minimally-invasive, and male infertility procedures, respectively.²⁴⁻²⁶ They reported that the presence of residents was not a significant predictor for the occurrence of adverse events and complications. This was also supported by Privé et al, Allard et al and Del Rosso et al that reported that although residents induced some complications, these were managed intraoperatively.²⁷⁻²⁹

The safety of residents' performance was furtherly indicated by Benjamin et al that reported that the presence of residents in laser prostate surgeries is not associated with significant rates of complications.³⁰ In the study by Ku et al, which assessed the performance during radical prostatectomy in 5,736 patients, they reported that residents' presence was not significantly associated with the presence of complications or the need to perform a blood transfusion.³¹ In 2019, Holland et al reported that the rate of complications was higher in the resident group, but not significant.³² Moreover, the involvement of residents in inpatient care significantly decreased the rate of complications. Aisen et al found significantly high rates of complications in the resident's group, although they performed on younger patients and with significantly higher rates of comorbidities than the group that did not comprise residents' involvement.³³ Kern et al also reported that the presence of residents and fellows was a significant predictor for overall and serious complications in minimally-invasive and nephrectomy procedures.³⁴ In hydrocele repair surgeries, residents' involvement was not a risk for and was not associated with developing complications.³⁵ During vasectomy operation, Nguyen et al assessed the rates of complications and pain by the

visual analog score (VAS) between residents and senior urologists.³⁶ Although the rate of complications and mean VAS score were higher in the residents' group, the difference was not significant. A previous study by Nieder et al reported that the rate of complications after transurethral bladder tumor resection, the rate of complications was 5.8% for both fellow and resident trainees under supervision.³⁷ However, the authors reported that the rates of complications and bladder perforation could be more frequent with senior urologists than trainees, however, no statistical analysis was done. Moreover, McAbee et al reported that the rate of infection was 0.3% only following penile prosthesis placement surgeries.³⁸

Impact on the rates of reoperation

In the study by Matulewicz et al, the presence of residents was associated with significantly lower rates of reoperations as compared to the non-residents' population which was also supported by Holland et al, and Allard et al on the other hand, Meyer et al reported that none of the patients were readmitted for reoperation in their study, which was also reported by Löppenberg et al, although attendant students had some rates of reoperation and readmission, but with no significance.^{23,24,28,32,35} Moreover, Benjamin et al reported that reoperations were not significantly associated with residents' performance in a 6-month follow-up period. This was also reported by Ku et al, and Yip et al.^{26,30,31}

Impact on the operative time

Matulewicz et al reported that the residents' population had significantly higher operative times and hospital stays, which is also reported by Kern et al, Aisen et al, Allard et al, Yip et al.^{23,24,26,33,34} Although the presence of residents was significantly associated with increased operative time in the performed surgeries, the length of hospital stay was not significantly different from the non-resident group, in the studies by Meyer et al, and Vetterlein et al, Benjamin et al, and Privé et al reported that longer operative time was associated with the residents' group, however, no complications were significantly noticed.^{24,25,27,30} Interestingly, Ku et al reported that patients that underwent surgeries by residents did not significantly stay in hospitals for longer periods although the operative time was significantly prolonged in these patients.³¹ Longer operative time was also reported by Holland et al³². Löppenberg et al.³⁵ reported that both residents and post-graduate students had an increased risk of prolonged operative time.

These results suggest that residents' involvement does not significantly affect the safety of the patients undergoing urological procedures, despite not being time efficacious. Our results are also consistent with previous studies from other medical departments. A previous meta-analysis by Boughie et al showed that residents' involvement in obstetrics and gynecology surgeries was not significantly

associated with the development of complications but with prolonged operative periods and risk of performing frequent blood transfusions.³⁹ On the other hand, residents' involvement in high-risk operations might increase the risk of mistakes and increase the rates of complications and hospital stay, and therefore, high-risk operations should be subjected to strict supervision to minimize the possible mistakes and obtain the best outcomes.⁴⁰ It is also worth mentioning that, although the presence of video and supervision assistance might add to the efficacy of the performing residents, Pycha et al still reported that the rate of complications was high (16%) for these residents.^{17,29,41} However, such studies were excluded as previously discussed to obtain better non-biased evidence regarding the overall safety and efficacy of residents alone.

The absence of randomization in the included studies might be a limitation to our study. Moreover, many studies were conducted on a retrospective basis and not all studies have reported the detailed outcomes that may result secondary to the residents' involvement. Although the evidence in our study might be strong enough due to the number of included studies and the absence of significant heterogeneity, we recommend that randomized studies should be conducted for better validation of the evidence.

CONCLUSION

Our results encourage the practices of residents' involvement in urological surgical procedures to obtain the required experience. Our recommendations are built on the obtained evidence from the included studies which showed that residents' involvement is not associated with significant reoperations, complications, and adverse events. The main issue would represent the longer operative time consumed by residents; however, this would be the cost for a better quality of care and an excellent experience for these residents.

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