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The effect of gender on operative autonomy in general surgery residents

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ABSTRACT

Background: Despite an increasing number of women in the field of surgery, bias regarding cognitive or technical ability may continue to affect the experience of female trainees differently than their male counterparts. This study examines the differences in the degree of operative autonomy given to female compared with male general surgery trainees.

Methods: A smartphone app was used to collect evaluations of operative autonomy measured using the 4-point Zwisch scale, which describes defined steps in the progression from novice ("show and tell") to autonomous surgeon ("supervision only"). Differences in autonomy between male and female residents were compared using hierarchical logistic regression analysis.

Results: A total of 412 residents and 524 faculty from 14 general surgery training programs evaluated 8,900 cases over a 9-month period. Female residents received less autonomy from faculty than did male residents overall ($P < .001$). Resident level of training and case complexity were the strongest predictors of autonomy. Even after controlling for potential confounding factors, including level of training, intrinsic procedural difficulty, patient-related case complexity, faculty sex, and training program environment, female residents still received less operative autonomy than their male counterparts. The greatest discrepancy was in the fourth year of training.

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Conclusion: There is a sex-based difference in the autonomy granted to general surgery trainees. This gender gap may affect female residents' experience in training and possibly their preparation for practice. Strategies need to be developed to help faculty and residents work together to overcome this gender gap.

Introduction

Autonomy in the operating room is a key aspect of surgical training because it allows residents to explore their limits and develop confidence in their skills. Despite its importance, surgery residents receive less operative autonomy in training than either they or faculty expect for common operations.[1,2] There are known procedural and surgeon factors that contribute to the operative autonomy allowed, including resident clinical skill, level of training and contact time, and attending confidence and operative complexity or difficulty.[3] Additional social and cultural factors, however, may also influence operative autonomy, such as productivity demands, the medical-legal climate, and the gender of the resident and/or faculty surgeon.

A survey conducted by members of the Association of Women Surgeons found that 67% of female residents reported experiencing discrimination, most commonly as lack of respect from the medical team and inappropriate verbal exchanges.[4,5] Participants reported that events which were more common in past decades, such as inappropriate firing, barriers to hiring, and sexual harassment, are perceived to be less common now. Although overt discrimination has become less socially and corporately acceptable, implicit or unconscious bias still may be driving persistent discrimination. Implicit bias is unrecognized by the holder and may even contradict their stated beliefs.[6] For example, despite a growing number of women in medicine, leadership roles are predominantly filled by men.[7] In addition, women are paid less for the same work upon completion of their training, even after accounting for age, experience, specialty, faculty rank, and clinical and research productivity.[8,9] This study explored differences in the degree of autonomy granted to male and female general surgery residents as perceived by both residents and faculty.

Methods

Study design and participants

The Procedural Learning and Safety Collaborative is a group of over 50 surgical training programs working to improve resident education and patient safety. As part of this mission, categorical general surgery residents and surgery faculty at 14 university-affiliated, general surgery programs were recruited to use a smartphone app (SIMPL [System for Improving and Measuring Procedural Learning], Procedural Learning and Safety Collaborative, Ann Arbor, MI, USA) to evaluate resident autonomy in the operating room. Participation was voluntary, and institutional review board approval was obtained from each site. Rater training was provided in person at each site using a standardized curriculum.[10]

Data collection

The gender of the residents and faculty and the resident postgraduate year of training (clinical postgraduate years 1–5) were recorded for each enrolled subject. At the completion of an operative procedure, SIMPL was used to initiate an evaluation.[11] Each evaluation included 1 or more procedures selected from a taxonomy derived from the case log system of the Accreditation Council for Graduate Medical Education. To describe the intrinsic difficulty of different types of procedures, we categorized procedures using the designation by the Surgical Council on Resident Education of Core or Advanced Procedures, with advanced procedures defined as procedures that are not consistently part of general surgery practice.

Both the faculty surgeon and the resident were asked to evaluate the degree of autonomy the resident was granted during the procedure using the previously validated 4-point Zwisch scale.[12] This scale begins at "show and tell" and progresses through "active help" and "passive help" to "supervision only," which is the highest level of autonomy. Participants also scored patient-related case complexity and compared it with other cases of the same type (easiest one third, average, or hardest one third).

Statistical analysis

The primary outcome was the degree of autonomy that female residents received in the operating room compared with male residents, as evaluated by both the attending surgeon and the resident. Univariate comparisons of factors potentially affecting resident autonomy were assessed using Pearson χ^2 analysis, including year of training, patient-related case complexity compared with other procedures of the same type (eg, easiest one third of appendectomies), intrinsic procedural difficulty (eg, core versus advanced procedures), percentage of female residents or faculty at that institution, presence of a female department chair, presence of a female program director, resident gender, and faculty gender. Each factor was explored from the perspective of both the faculty evaluator as well as the resident. Factors contributing to autonomy based on this univariate analysis ($P < .05$) were then entered in a stepwise fashion into a multivariate logistic regression model to determine independent predictors of autonomy. A hierarchical model clustered by training program was used to account for variations in the local environment, such as differing case types commonly seen at each level of training based on rotation schedules. We repeated the analysis using Bayesian ordinal mixed models to account for all factors described earlier in addition to random procedure effects for attending, resident, and individual procedures. Logistic regression analyses were conducted using Stata software, version 14 (Stata Corporation, College Station, TX) and mixed models using R software, version 3.4.3, for Windows (R Core Team, Vienna, Austria), with the lavaan and brms packages.[13–15]

Results

In total, 412 residents and 524 faculty from 14 general surgery training programs evaluated 8,900 cases over a 9-month period, from September 2015 to June 2016 (Table I). Of those, 5,107 cases were evaluated by both the resident and the faculty surgeon for a 57.4% response rate. An additional 760 cases were evaluated by the faculty surgeon only, and 3,033 cases were evaluated by the resident only. Residents evaluated a mean (± standard deviation)

Table I
Program, faculty, and resident participation

	Male residents	Female residents	Total
Program demographics			
Number of programs			14
Participating residents per program	16.9 ± 6.9 (6–29)	12.4 ± 5.9 (3–21)	29.4 ± 12.0 (11–48)
Participating faculty per program	26.8 ± 15.2 (4–62)	10.5 ± 3.6 (5–16)	37.4 ± 17.4 (10–75)
Cases evaluated per program			636 ± 621 (46–2,343)
Faculty demographics			
Number of faculty	377	147	524
Cases performed by faculty (*n* [%] of total cases)	6,957 (78.2%)	1,943 (21.8%)	8,900 (100%)
Cases evaluated by faculty (*n* [%] of cases performed)	4,566 (65.6%)	1,301 (67.0%)	5,867 (65.9%)
Cases evaluated per faculty	18 ± 24 (1–216)	13 ± 20 (1–174)	17 ± 23 (1–216)
Number of faculty who did not respond to at least 1 evaluation request (*n* [%] of faculty)	110 (29.2%)	46 (31.3%)	156 (30.0%)
Resident demographics			
Number of residents	238	174	412
Cases performed by residents (*n* [%] of total cases)	5,458 (61.3%)	3,442 (38.7%)	8,900 (100%)
Cases evaluated by residents (*n* [%] of cases performed)	5,062 (92.7%)	3,078 (89.4%)	8,040 (90.3%)
Cases evaluated per resident	23 ± 27 (1–184)	20 ± 25 (1–170)	22 ± 26 (1–184)
Number of residents who did not respond to at least 1 evaluation request (*n* [%] of residents)	11 (4.6%)*	18 (10.3%)	29 (7.0%)

Data are means ± standard deviation (range), unless otherwise indicated.
* $P < 0.001$ male residents versus female residents.

of 22 ± 26 (range 1–184) cases. There was no difference in the average number of cases evaluated between male and female residents. Faculty evaluated a mean of 17 ± 23 (range 1–216) cases.

In unadjusted analyses, female residents received less operative autonomy than male residents, as evaluated by both faculty and residents ($P < .001$; Fig 1). Despite each additional year of training being associated with increased autonomy granted by faculty for both genders, at all levels of training, the autonomy granted to female residents was still less than that granted to male residents and reached statistical significance for the second, third, and fourth year of training when evaluated by faculty and in all except the third year of training when evaluated by residents (Fig 2). Univariate analysis additionally demonstrated statistically significant effects for patient-related case complexity, intrinsic difficultly of the procedure, and faculty gender. Within each of the groups of patient-related case complexity, women received less autonomy than men, with statistically significant differences for the average and the hardest one third of cases (Fig 3, *A*) from the faculty perspective and for average-complexity cases only from the resident perspective (not shown). Within both of the intrinsic difficulty groups (core and advanced procedures), women received less autonomy than men from both perspectives ($P < .04$ each; Fig 3, *B*). Faculty gender demonstrated a more mixed effect. From the resident perspective, both male and female attending surgeons granted more autonomy to male residents ($P < .001$). From the faculty perspective only, male faculty granted more autonomy to male residents ($P < .001$), while there was no difference among female faculty. The percentage of female residents or female faculty, having a female department chair, and having a female program director were not associated with any differences in autonomy by resident gender.

Multivariate ordinal logistic regression was performed, including all of the following variables showing statistical significance in univariate analyses: level of training, resident gender, faculty gender, intrinsic case difficulty, and patient-related case complexity. When controlling for all measured potential confounding factors, female residents received less autonomy than their male counterparts (Table II). Faculty gender was not associated with autonomy in the multivariate model from either the

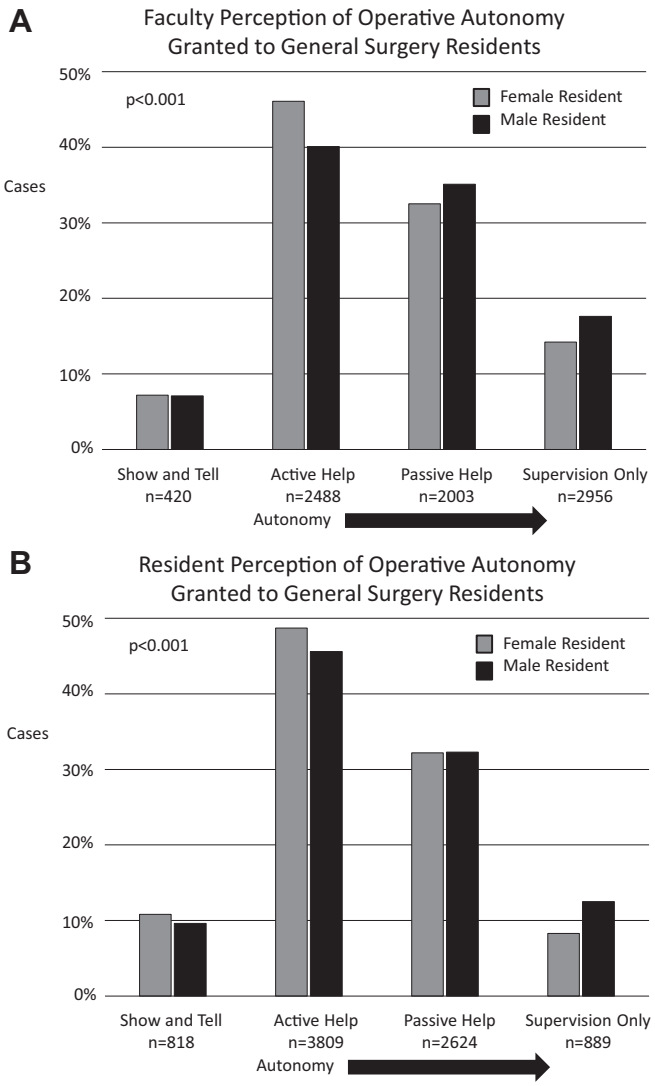

Fig 1. Operative autonomy granted to male and female general surgery residents from faculty (*A*) and resident (*B*) perspectives.

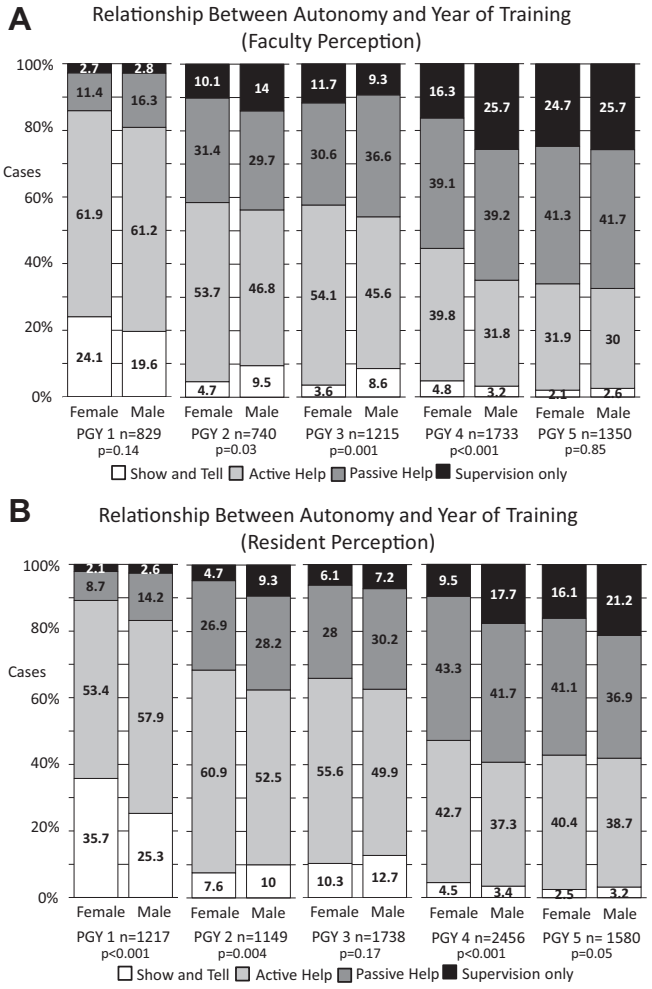

Fig 2. Operative autonomy granted to male and female residents in each year of training from faculty (*A*) and resident (*B*) perspectives.

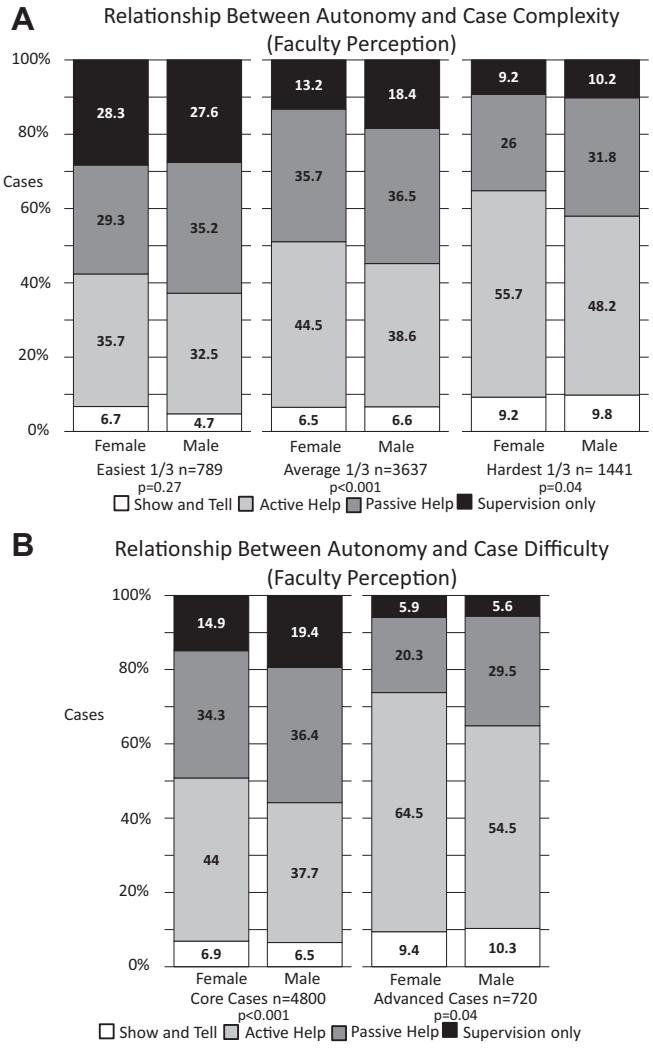

Fig 3. Operative autonomy granted to male and female residents based on perceived patient-related complexity of the operation compared with other operations of the same type (*A*) and intrinsic procedural difficulty rated using Surgical Council on Resident Education classification of core versus advanced procedures (*B*).

faculty or resident perspective. The results were confirmed using ordinal mixed models (results not shown).

Discussion

These data were from the largest study of the autonomy of surgery residents reported to date, and they demonstrate that women continue to receive less autonomy in the operating room than men. This difference in granting resident autonomy continues despite substantial progress toward gender equality in surgery. From the perspective of the faculty, male and female interns received equivalent autonomy, with >80% of cases performed at the "active help" or "show and tell" levels, as would be expected for novice surgeons. In the second, third, and fourth years of training, a statistically significant gender gap appeared because male residents progressed more rapidly to "passive help" and "supervision only." By their chief resident year, however, female residents were receiving equivalent autonomy to men. From the perspective of the residents, the gender gap was both more prevalent and more persistent. Residents reported an autonomy gap that started during the intern year and still existed in the chief resident year.

One might argue that the importance and relevance of these findings are lessened because, at least from the attending perspective, men and women in surgery receive equal autonomy by the end of training. The impact of these differences in both learning and self-confidence is, however, unknown. If women perceive that they are treated differently during training, the impact may be substantial and longstanding.[16]

One potential explanation for the apparent observed gender bias seen in our data is, we believe, the effect of gender normative stereotypes. Women experience a conflict in how their behavior is perceived. Behaviors in men, such as assertiveness and competitiveness, can be viewed as favorable, leading to success.[17] Men may, therefore, feel more empowered to ask for autonomy in the operating room, knowing that they are likely to be perceived as confident and engaged and rewarded appropriately. When women exhibit these same behaviors, they can be perceived as arrogant or argumentative. Most women are aware of how their gender affects how they are perceived, and they consciously alter their behavior to avoid being seen as bossy or overbearing.[18] Female residents may, therefore, avoid advocating for more autonomy for themselves owing to concerns of being labelled as entitled and overconfident. These cultural factors present challenges when contemplating how we should address the gender gap.

Gender norms also lead to differences in how people are evaluated. Reviewers who were given 1 of 2 versions of the same

Table II
Estimates of coefficients in a hierarchical logistic regression analysis of factors contributing to autonomy granted to residents in the operating room

	Attending surgeons' perceptions		Residents' perceptions	
	Parameter estimate (confidence interval)	Statistical significance	Parameter estimate (confidence interval)	Statistical significance
Level of training				
PGY 1	Reference		Reference	
PGY 2	1.47 (1.26–1.68)	$P < .001$	1.33 (1.10–1.55)	$P < .001$
PGY 3	1.57 (1.38–1.76)	$P < .001$	1.56 (1.36–1.77)	$P < .001$
PGY 4	2.44 (2.25–2.63)	$P < .001$	2.40 (2.21–2.60)	$P < .001$
PGY 5	2.82 (2.62–3.02)	$P < .001$	2.67 (2.46–2.89)	$P = .002$
Patient-related case complexity				
Easiest one third	Reference		Reference	
Average	−0.57 (−0.73 to −0.42)	$P < .001$	−0.40 (−0.57 to −0.23)	$P < .001$
Hardest one third	−1.34 (−1.52 to −1.17)	$P < .001$	−0.88 (−1.07 to −0.69)	$P < .001$
Case difficulty				
Advanced	Reference		Reference	
Core	1.25 (1.09–1.40)	$P < .001$	1.23 (1.06–1.40)	$P < .001$
Resident sex				
Female	Reference		Reference	
Male	0.26 (0.15–0.37)	$P < .001$	0.30 (0.18–0.42)	$P < .001$
Attending faculty sex				
Female	Reference		Reference	
Male	−0.77	$P = .25$	−0.09	$P = .18$

The analysis of attending faculties' perception uses evaluation data submitted by attending faculty based on their perspective of the autonomy granted in the operation. The analysis of the residents' perception used evaluation data submitted by residents based on their perspective of the autonomy they received.
PGY, postgraduate year.

application for employment, with the only difference between the 2 being the name or gender of the applicant (Jane Doe versus John Doe), uniformly rated the male applicant as more hirable. This bias is even more prominent when the job was one historically or predominantly occupied by men.[19,20] In the academic arena, a study of the National Institutes of Health's process of peer review of RO1 grants showed that male applicants received more competitive scores, even after controlling for experience, age, and productivity.[21] Specifically relating to resident evaluation, Dayal et al[22] showed differences in attainment of Accreditation Council for Graduate Medical Education training milestones between male and female emergency medicine residents. Although they started at the same level in their first year, male residents progressed more rapidly through the milestones. At graduation, male residents scored higher on milestones than female residents at a rate equivalent to an extra 3 or 4 months of training.

Faculty must work actively to create an environment that enables women to achieve similar levels of autonomy as men. At the departmental level, small changes in how women are treated can have a major impact at all levels. Files et al[23] identified a subtle form of bias, where male speakers at grand rounds were introduced most commonly by their professional titles, whereas female speakers were introduced by their first names over half of the time. Discussing these types of issues as a department can raise consciousness and increase the professional respect shown to female faculty. Reviewing their personal data on granting of autonomy to male and female residents may help faculty recognize their own biases.

Some simple teaching techniques to increase autonomy may benefit both our male and female trainees. For example, in challenging situations, faculty should push residents to verbalize their thought process and help them decide and execute the next steps rather than taking over the case. If it becomes necessary to take over a portion of the procedure, faculty should hand back control to the resident when the crisis or challenge has passed. Taking away autonomy at the first sign of struggle reinforces the residents' perception that they are not good enough. Handing control back sends the message that the faculty surgeon is confident they can continue. Altering the mindset of the resident is also likely to be a key component in improving autonomy. Female residents should be encouraged to recognize instances when they are being less aggressive owing to fear of how they will be perceived and identify opportunities to advocate for themselves. Rather than waiting for faculty direction, female residents need to be empowered to vocalize their own ideas about how to proceed and thereby allow the faculty member to confirm or deny the proposed course of action. By demonstrating that they have thought through the next steps, the trainee hopefully will build the confidence the faculty surgeon has in their abilities, even if their plan is not completely correct. This recognition and assertiveness requires a conscious effort on the part of faculty to either wait for the resident to decide how to proceed or prompt the resident to discuss options and make a decision rather than jumping in to provide the answer. The key is to create a departmental climate where women feel safe advocating for themselves and know that their faculty and colleagues will support them.

Our study does have some limitations. All institutions in this study were university affiliated, so this study may limit the generalizability to community-based programs. Because evaluations were voluntary, there is potential for selection bias in the cases both residents and faculty chose to evaluate. Residents may be less likely to submit an evaluation for a case in which they either performed poorly or did not feel they received appropriate autonomy. Either of these situations would artificially increase the measured autonomy and, if there is an interaction with gender, could have biased our results. Future efforts focusing on autonomy should try to increase the proportion of total cases evaluated to limit this effect. One option would be to create a mechanism that logs the residents' cases at the same time the evaluation is generated, thereby leading to better capture. Although we controlled for a number of factors that would be expected to affect the level of resident autonomy, unmeasured or unappreciated confounders may also influence these results.

In conclusion, less operative autonomy is granted to female residents than male residents, when controlling for program-level factors, case type and complexity, and level of training. Our study shows that further research is needed to better understand the impact of gender bias on surgery residents, and this probably holds

true for female surgeons after their training. A conscious effort on the part of programs, faculty, and residents is required to address these challenges.

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Conflict of interest/Disclosure

The authors report no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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