

# Do Men Outperform Women During Orthopaedic Residency Training?

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## Abstract

**Background** Orthopaedic surgery residency has one of the lowest percentages of women (13.1%) of all primary surgical specialties. There are many possible reasons for this, including bias during the selection process.

**Questions/purposes** We therefore asked whether performance during residency might adversely bias the selection of future female orthopaedic residents by researching whether males and females perform equally in orthopaedic surgery residency.

**Methods** Ninety-seven residents enrolled in our residency between 1999 and 2009; six males and one female left the program, leaving 90 residents (73 males, 17 females) as the

study cohort. Resident performance was compared for OITE scores, ABOS results, faculty evaluations, and in a resident graduate survey.

**Results** Males and females had similar faculty evaluations in all ACGME competency areas. Males and females had similar mean OITE scores for Years 2–5 of residency, although males had higher mean scores at Years 3 through 5. Males and females had similar mean ABOS Part 1 scores and ABOS Part 1 pass rates; however, fewer males than females took more than one attempt to pass. Males and females had similar Part 2 pass rates or attempts. For the 45 resident graduates surveyed, females pursued fellowships equally to males, worked slightly less hours in practice, and reported higher satisfaction with their career choice.

**Conclusions** For the 90 residents at one residency program, we observed no differences between males' and females' performance. Although females pursue orthopaedic residency less frequently than males, performance during residency should not bias their future selection.

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Each author certifies that his or her institution approved or waived approval for the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at the Department of Orthopaedic Surgery, University of Minnesota, Minneapolis, MN, USA.

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## Introduction

One of the major diversity issues confronting orthopaedic surgery is the lack of females in the profession. Although half of undergraduates in the United States are female and 49.1% of medical students are female, only 13.1% of orthopaedic surgery residents are female [6, 7]. Despite the increasing percentage of females in orthopaedic residency programs in the last 10 years (13.1% in 2009 versus 6.9% in 1998), other surgical specialties such as general surgery (32.4%) and urology (21.6%) still have far greater female participation [6, 7].

When ranking residency specialties by size, orthopaedic surgery ranks tenth in the United States with 153 accredited

orthopaedic residency programs training 3303 residents in 2008–2009 [6]. In 2008–2009, general surgery had 32.4% of its 7712 positions filled by women; plastic surgery had 24.8% of 508 positions; colorectal surgery had 31.5% of 73 positions; urologic surgery had 21.6% of 1031 positions; and cardiothoracic surgery had 13.9% of 230 positions filled by women. The only surgical specialty that had fewer females than orthopaedic surgery was neurologic surgery in which women filled 12.2% of the 961 positions [6]. Workload alone cannot explain these discrepancies because other surgical specialties with long hours and demanding call schedules such as general surgery and obstetrics–gynecology continue to attract a greater percentage of females (32% and 78%, respectively) than orthopaedic surgery.

Why are women not entering orthopaedic surgery at the same frequency as in other demanding surgical specialties? One possible barrier to females being accepted into orthopaedic residency could be the perception in some orthopaedic programs that they do not perform as well as males.

We therefore examined the following question: do males and females perform equally in orthopaedic surgery residency as measured by faculty evaluations of residency performance in all ACGME competency areas, OITE scores, ABOS scores, and resident graduates' practice patterns?

## Materials and Methods

We retrospectively reviewed the performance of all orthopaedic residents matriculated at the University of Minnesota Department of Orthopedic Surgery between 1999 and 2010. Ninety-seven residents (79 males, 18 females) were matriculated with graduation years of 1999 to 2012. One female and six males did not finish the program, leaving 90 residents (73 males, 17 females) as the cohort for this study. The performance of male and female residents during training was evaluated with E-Value© faculty evaluations of resident performance, Orthopaedic In-Training Examination (OITE) scores, and American Board of Orthopaedic Surgery (ABOS) Part 1 scores with number of attempts to pass ABOS Parts 1 and 2 as outcome measures. Exemption was obtained from the Institutional Review Board for this study.

The faculty evaluations use an electronic web-based format, E-Value©, to rank each resident in each of the American College of Graduate Medical Education (ACGME) standardized competencies (medical knowledge, interpersonal communication skills, professionalism, patient care, systems-based practice, practice-based learning, and improvement) as well as a ranking of overall competence and technical skills. Each resident was given a

score of 1 to 5 with 1 as the lowest score, 3 as commensurate with the level of training, and 5 as outstanding. The E-Value© system has been in place out our institution for 10 years and is used by all faculty at every training site for each resident.

OITE scores from the years 1994 to 2008 were gathered through our program director using raw scores data. The ABOS results for Part 1 were assessed by raw scores and by number of attempts required to pass. Because the scores given were reported in percentiles during the years 1999 to 2004, the ABOS was contacted and provided the raw scores that allowed appropriate statistical comparison with the standardized score reporting for years 2005 to 2008. For ABOS Part 2, only the number of passing attempts was analyzed because raw scores are not given.

To compare the practice profiles and postresidency practice patterns of our recent graduates, an electronic web-based survey focused on fellowship training, current practice (academic versus private), call schedule, family life, and career satisfaction was sent to all resident graduates (Appendix). (Supplementary website materials may be found with the online version of CORR.) Forty-five of the 53 graduates completed the survey for an 85% response rate.

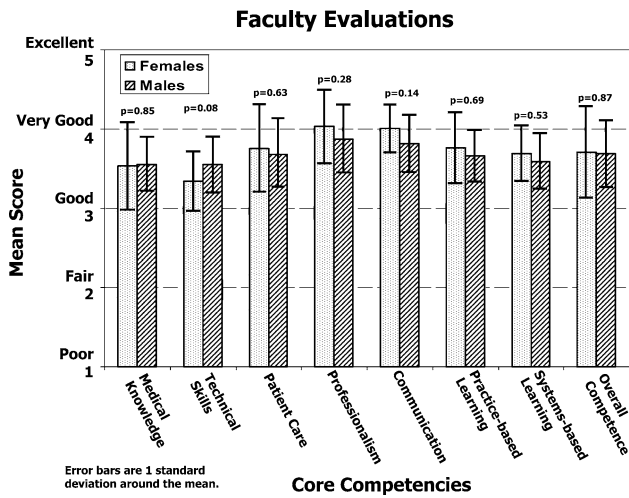
Using these data, we compared the performance of men and women during orthopaedic surgery residency training and compared the practice profiles of those residents who graduated from the program. We used the Student's *t*-test and Wilcoxon rank sum test to compare OITE scores, ABOS Part 1 scores, and E-Value© competency measurement scores. Fisher's exact test and Pearson's chi square test were used to compare the number of pass attempts for ABOS Part 1 and Part 2 and the practice profiles of graduated residents. We used a post hoc Bonferroni correction for multiple comparisons and report differences after those corrections. SPSS (Version 15.0, Chicago, IL) was used for all analyses.

## Results

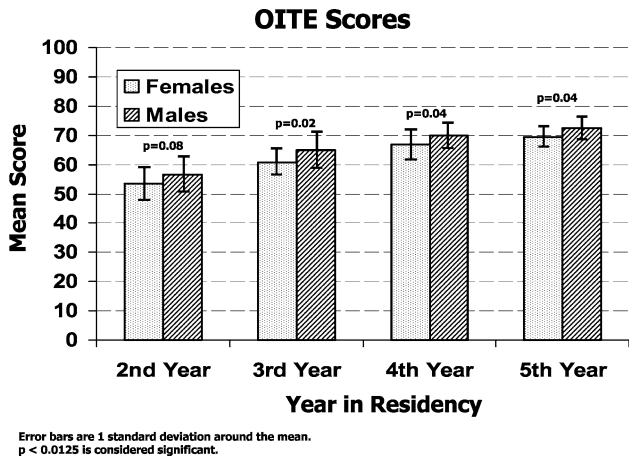
We observed no difference between female and male performances in any of the eight ACGME competencies as measured by faculty electronic evaluations (Fig. 1). Although small differences were observed between females and males, there were no statistical differences in any of the ACGME competency areas or the added areas of technical skills and overall competency.

OITE scores were similar between females and males in all years of residency. We observed no differences in the second, third, fourth, and fifth year scores (Fig. 2).

The ABOS Part 1 scores were similar between females and males. From 1999 to 2004, the average percent correct for females was similar ( $p = 0.68$ ) to that for males (75%



**Fig. 1** The mean E-Value® rating for men and women in each of the six core American College of Graduate Medical Education competencies and the additional measures of technical skills and overall competency is displayed.



**Fig. 2** The mean score on the annual Orthopaedic In-Training Examination (OITE) for male and female residents in each year of training is displayed. The p values are after post hoc correction for multiple comparisons.

versus 76%, respectively) and from 2005 to 2008, the average standardized score was similar ( $p = 0.50$ ) for females and males (198.0 versus 203.2, respectively). Although there were no differences between females and males on the ABOS Part 1 examination, females took a greater ( $p = 0.05$ ) number of attempts to pass the ABOS Part 1 exam. Three of 10 females (30%) and three of 49 males (6%) required more than one attempt to pass. There was no difference in the number of passing attempts for ABOS Part 2.

The survey of our resident graduates showed no difference ( $p = 0.45$ ) in the number of female (six of eight [75%]) and male residents (22 of 38 [58%]) who decided to pursue a fellowship. Four of the six women completed

**Table 1.** Selected results of the survey questionnaire sent to resident graduates

Survey questions	Females	Males
Age group		
30–34	5 (63%)	33 (87%)
35–44	3 (38%)	5 (13%)
Marital status		
Single/Divorced	2 (25%)	18 (119%)
Married	6 (75%)	31 (82%)
Children		
No	3 (38%)	11 (29%)
Yes	5 (63%)	27 (71%)
Children born before residency		
No children	7 (88%)	33 (87%)
1 or more children	1 (13%)	5 (13%)
Children born during residency		
No children	7 (88%)	19 (50%)
1 or more children	1 (13%)	19 (50%)
Children born after residency		
No children	4 (50%)	17 (45%)
1 or more children	4 (50%)	21 (55%)
Fellowship		
No	2 (25%)	16 (42%)
Yes	6 (75%)	22 (58%)
Type of fellowship(s)		
Adult Reconstruction	0 (0%)	5 (20%)
Foot/Ankle	0 (0%)	5 (20%)
Hand	4 (67%)	1 (4%)
Pediatric	1 (17%)	1 (4%)
Spine	0 (0%)	5 (20%)
Sports	1 (17%)	6 (24%)
Trauma	0 (0%)	2 (8%)
Tumor	0 (0%)	0 (0%)
Number of hours worked/week		
31–60	6 (75%)	12 (32%)
61 or more	2 (25%)	26 (68%)
Number of call days/month		
0–4	6 (75%)	11 (29%)
5 or more	2 (25%)	27 (71%)
Number of calls /month compared to group		
Less than or equal to most	8 (100%)	28 (74%)
More than most	0 (0%)	10 (26%)
Satisfaction with career		
Dissatisfied/Neither	1 (13%)	3 (8%)
Satisfied/Very Satisfied	7 (88%)	35 (92%)
Would choose orthopaedics again		
No	0 (0%)	4 (11%)
Yes	8 (100%)	34 (90%)
Would choose medicine again		
No	2 (25%)	7 (18%)
Yes	6 (75%)	31 (82%)

a hand fellowship. There were differences between females and males in hours worked per week and number of call days per month. Females on average worked fewer hours and took less calls than their male counterparts. Seventy-five percent of females and 32% of males worked between 31 and 60 hours per work week; 25% of females and 68% of males worked over 60 hours per week. No females worked over 80 hours per week, whereas 11% of males did work over 80 hours per week. Seventy-five percent of females and 29% of males took calls between zero and four times per month; 25% of females and 71% of males took calls more than five times per month ( $p = 0.04$ ). In ranking their career satisfaction as orthopaedic surgeons, 100% of females and 90% of males stated they would choose orthopaedics again. A total of 63% of females and 65% of males reported being very satisfied with their careers (Table 1).

## Discussion

Although 49.1% of medical students are female, only 13.1% of orthopaedic residents are female [6]. Female medical students are choosing other surgical specialties at substantially higher rates than orthopaedic surgery. We chose to examine performance during residency, because one possible barrier to admission of females into residency could be the perception in some orthopaedic programs that females do not perform as well as males; this does not reflect our own experience. We asked whether males and females would perform equally well during residency using different outcome measures.

The study has obvious limitations. First is the issue of whether our sample is representative of other programs. The relatively high number of female residents enrolled in our program over the past 10 years (20%) may not reflect the experience of other institutions with fewer females. A multi-institutional study would be necessary to limit this concern. Second, the faculty evaluations give the most insight into performance during residency, but they remain subjective and prone to bias. However, over 40 faculty members in our program use this comprehensive electronic evaluation for all residents on all rotations and have done so for over 10 years, supporting the concept that our faculty members did not perceive a difference between male and female performance during residency. Finally, we cannot determine what deters women from entering orthopaedic surgery as a profession. We did not study the 95% of graduating females who elect other fields and have data only related to performance of those who did enter orthopaedic surgery.

We can tackle the question of potential selection bias by examining the performance of those who did select

orthopaedics. Other authors have examined this issue, including Scherl et al. [13] who examined the issue of possible gender bias during the interview selection process. Residency applications blinded to gender were given to blinded reviewers (program directors and department chairs); no difference in the ranking of the female and male applicants was found. This study suggests women are not discriminated against during the initial Electronic Residency Application Service chart review process; our study indicates women who are selected perform well and become competent, successful surgeons. We believe it is unlikely bias was introduced against female applicants during the interview process in our institution given our experience. The problem of small numbers of women choosing orthopaedic surgery as a career appears to begin with failure to attract female medical students to apply to orthopaedic residency programs.

A number of barriers may exist for women pursuing a career in orthopaedic surgery. Several studies demonstrate early exposure has a positive correlation with matching into a surgical career [8–10, 12]. There is a lack of musculoskeletal education during medical school and orthopaedic clinical rotations are frequently not required. Unless the student is exposed to orthopaedic surgery and musculoskeletal pathology before entering medical school, an interest may never develop. Bernstein et al. showed mandatory musculoskeletal education encouraged a higher application rate to orthopaedic surgery residency, especially among females and minorities [4]. This study may indicate that men are entering medical school focusing on orthopaedic surgery, and women do not have adequate exposure during medical school to choose orthopaedic surgery as a career choice.

Why are studies such as this one important to the field of orthopaedic surgery? In 2007 to 2008, women comprised 49.1% of all US medical school graduates [1]. This percentage is predicted to increase. Orthopaedic surgery remains one of the primary surgical subspecialties with the lowest percentage of female residents [5]. If the field of orthopaedic surgery wants to continue to attract and employ the “best and the brightest” students as residents, it cannot afford to only draw applicants from half of the applicant pool.

The American Academy of Orthopaedic Surgeons has made gender diversity a topic of special interest. Similarly, the American Association of Neurological Surgeons has identified a major problem with recruitment of women into neurosurgery and cites obstacles such as the lack of a critical mass of female neurosurgeons in academic medicine to serve as role models, gender inequity for acceptance into residency, unfair treatment for promotion, and limited opportunities for advancement of their careers as female neurosurgeons [3]. Whether similar circumstances exist in

the orthopaedic community bears scrutiny. Only 7% of orthopaedic faculty members are females, and there are only 15 females in the country who hold full professorships [11]. It is important for female residents and students to have visible examples of competent, successful female orthopaedic surgeons [2].

Our data suggest female residents perform equally to males during residency; females complete our residency program with equal frequency as males; females are equally satisfied with their career in orthopaedic surgery. Given the relatively large numbers of females in our program and similar performance in females and males we found no evidence for selection bias against females based on any perceptions of differential performance. Additional research efforts are needed to evaluate gender differences in other residency programs across the country as well as further examination of other barriers for female medical students in applying to orthopaedic surgery residency programs.

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