An Original Study

Impact of a Musculoskeletal Clerkship on Orthopedic Surgery Applicant Diversity

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Abstract

Orthopedic surgery lacks racial and sexual diversity, which we hypothesized stems from absence of exposure to orthopedics during medical school.

We conducted a study to determine whether diversity of matched orthopedic surgery residency applicants increased after introduction of a required third-year rotation. We compared 2 groups: precurriculum and postcurriculum. The postcurriculum group was exposed to a required 1-month musculoskeletal rotation during the third year of medical school. Comparisons were made of percentage of total students exposed to orthopedics, percentage who applied to and matched to orthopedic surgery, and proportion of women and underrepresented minorities. A prospective survey was used to determine when students chose orthopedics and what influenced their decisions.

The required rotation increased the percentage of third-year students rotating on orthopedics (25%) with no change in application rate (6%). It also led to an 81% relative increase in the proportion of female applicants and a 101% relative increase in underrepresented minority applicants. According to survey data, 79% of students chose orthopedics during their third year, and 88% thought they were influenced by their rotation.

A required third-year rotation exposes more medical students to orthopedics and increases the diversity of matching students.

As the United States becomes increasingly diverse, with predictions that by 2045 minorities will comprise 50% or more of the population,[1] the demographics of the orthopedic surgery population will also likely diversify. It is important that orthopedic surgeons shift in their diversity as well. Lack of diversity in orthopedics (women and racial minorities are underrepresented) relative to the national population and other surgical specialties and their training programs is well documented.[2-8]

More concerning, the diversity of orthopedic residents does not compare favorably with that of medical school attendees.[4,9] The difference suggests the greatest loss of potential diversity occurs during the transition from medical school to residency. A national study demonstrated that instruction in musculoskeletal medicine led to an increase in application rates nationally.[10] However, the authors of that study stated they were unexpectedly limited by its large size—they could not validate the accuracy of curriculum data and could not differentiate between a 1-day required experience and a 4-week rotation.

In the present study, which accounted for curricular factors, we compared our medical students' application rates to orthopedics residencies based on sex and race before and after introduction of a required third-year musculoskeletal clerkship. We hypothesized that making the curriculum a requirement would increase the number of applicants and increase the diversity of applicants in terms of both women and underrepresented minorities. This hypothesis was based on the rationale that these groups might not consider an orthopedics residency without first being directly exposed to orthopedics. We also wanted to determine what factors influenced applicants to choose orthopedic surgery.

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Methods

Curriculum

Before 2006, third-year students spent 3 months completing a surgery clerkship. Some students interested in orthopedic surgery would have to wait until their fourth year to complete an elective in orthopedic surgery, and uninterested students would not be exposed at all. Starting in 2006, 1 month of the third-year surgery clerkship was required to be completed in musculoskeletal surgery: orthopedic surgery, plastic surgery, or neurosurgical spine. Plastic surgery was an option, as it exposed students to hand surgery and flap reconstruction. The orthopedic surgery curriculum included two 2-week experiences with an orthopedic surgeon (**Table 1**), twice-weekly lectures by orthopedics faculty, weekly physical examination sessions, and 3 or 4 nights of call.

During the 12-year study period, overall teaching hours in the preclinical curriculum did not change, and there were no other structural changes to the preclinical or clinical curriculum. The orthopedics department increased its faculty from 23 in 2000 to 34 in 2012. Number of female faculty increased from 1 to 3, representing a 4% to 9% increase in department faculty. Throughout the 12 years, there were no underrepresented minority faculty. Total number of residents increased from 26 in 2000 to 30 in 2012. Number of female residents varied year to year, from a low of 3 in the period 2003–2004 to a high of 11 in the period 2009–2010. Number of underrepresented minority residents varied yearly as well, from 1 to 2.

Data Collection

After this study was granted exempt status by our Institutional Review Board, we obtained student data from our registrar. Data included graduation year, self-identified sex and race, exposure to orthopedic surgery during clerkships, and matching residency specialty. National data were obtained from the Electronic Residency Application Service for the periods 2002–2007 and 2009–2012. These data included all US allopathic medical students' self-identified sex and race, and applied-to primary residency specialty. National data from 2008 and national data on sex differences in orthopedic applications from 2009 were not available.

Graduates who matched into orthopedic surgery were asked to complete an anonymous survey on what influenced their decision to apply to orthopedic surgery and when this decision was made. Our goal with the survey was to substantiate or refute the conclusion that application rates depended on third-year exposure to musculoskeletal medicine.

Statistical Methods

Students were divided into 2 groups: precurriculum (graduated within 7-year period, 2000–2006) and postcurriculum (graduated within 6-year period, 2007–2012). A 2-sample test for proportions was used to compare percentage of total students who applied to orthopedics in each group. In the group of students who applied to orthopedics, we compared precurriculum and postcurriculum proportions of women and underrepresented minorities (nonwhite, non-Asian). We also compared these proportions with national data (using 2-sample tests for proportions) to determine if any change in diversity of our institution's applicants was mirroring a national trend. Our definition of underrepresented minority was based on work that showed that the proportion of Asian matriculants in medical school and the proportion of applicants to orthopedics are higher than their respective national proportions.[5] Survey data are reported descriptively. Statistical significance was defined with a 2-tailed α of 0.05 for all tests.

Table 1. **Scheduled Combinations of Orthopedic Subspecialties for Students**

Option	Weeks 1-2	Weeks 3-4
1	Hand	Reconstruction
2	Shoulder/Elbow	Oncology
3	Physical Medicine/Rehabilitation	Spine
4	Rheumatology	Veterans Affairs
5	Pediatrics	Sports
6	Sports	Foot/Ankle
7	Trauma	Trauma

Results

Over the 2000–2012 period, 1507 students from our institution successfully applied to residency programs: 792 in the precurriculum group and 715 in the postcurriculum group. Of these students, 91 successfully applied to orthopedic surgery: 48 in the precurriculum group (applied before introduction of the required clerkship) and 43 in the postcurriculum group (applied afterward). Each cohort represented 6% of the total number of students. **Table 2** lists the groups' demographics.

Over the 2002–2012 period, 10,100 US allopathic medical students applied to orthopedic residency

programs: 4769 students between 2002 and 2006 and 5331 students between 2007 and 2012. **Table 3** lists these groups' demographics.

Before the musculoskeletal clerkship was required, 317 (40%) of the 792 precurriculum students were exposed to orthopedics during their third year. During this period, 42 of the 48 orthopedic surgery applicants completed an orthopedic surgery rotation during their third year of medical school. After the clerkship was required, 465 (65%) of the 715 postcurriculum students were exposed to orthopedics during their third year, including all 43 orthopedic surgery applicants (100% of students were exposed to musculoskeletal surgery, including plastic surgery and neurologic spine). The 25% increase in exposure to orthopedic surgery during the third year was statistically significant ($P < .0001$), but there was no resultant increase in overall percentage of students applying to orthopedic residencies (6% in each case; $P = .98$).

Over the 12-year study period, the proportion of female medical students at our institution declined from 50% (395/792) to 46% (328/715) ($P = .13$). However, there was an 81% relative increase, from 17% (8/48) before introduction of the clerkship to 30% (13/43) afterward, in the proportion of female applicants to orthopedic surgery. This contrasted with national data showing the percentage of female applicants to orthopedic surgery remained stable from 2002–2006 (14%, 675/4758) to 2007–2012 (15%, 643/4277). Before the clerkship was required, the proportion of female applicants from our institution was similar to national rates ($P = .50$). Afterward, our institution produced a significantly higher proportion of female applicants compared with the national proportion ($P = .026$).

Over the 12-year period, our self-identified underrepresented minority medical student population increased significantly ($P = .02$), from 13% (103/792) to 17% (124/715). The relative proportion of underrepresented minority orthopedic surgery applicants increased by 101%, from 10% (5/48) before the clerkship was required to 21% (9/43) afterward. Nationally, over the same period, underrepresented minorities' orthopedic surgery application rates increased significantly ($P < .001$), from 16% (763/4769) to 19% (1002/5331). The proportion of underrepresented racial minorities that applied did not differ significantly between our institution and nationally for the years either before ($P = .97$) or after ($P = .68$) introduction of the curriculum.

Surveys were completed by 58 (64%) of 91 graduates (21 women, 70 men). Respondents' characteristics are listed in **Table 4**. Eighteen (86%) of the 21 female graduates completed the survey: 6 (75%) of 8 precurriculum and 12 (92%) of 13 postcurriculum. Only 5 (36%) of 14 underrepresented minorities completed the survey, all postcurriculum. Of the 28 precurriculum respondents, 22 (79%) decided to apply to orthopedic surgery during their third or fourth year, and this was true for 25 (83%) of 30 postcurriculum respondents. Of all 58 respondents, 51 (88%) indicated that their third-year rotation in musculoskeletal medicine influenced their choice of specialty. Specifically, 3 precurriculum respondents (1 female) had no interest in orthopedic surgery until their third-year

Table 2. **Number and Percentage of Applicants to Orthopedics at Our Institution**

Musculoskeletal Curriculum Exposure, Period	Sex, n (%)		Race, n (%)		
	Male	Female	White + Asian	Minority	N (%)
No, 2000–2006	40 (83%)	8 (17%)	43 (90%)	5 (10%)	48 (6%)
Yes, 2007–2012	30 (70%)	13 (30%)	34 (79%)	9 (21%)	43 (6%)

Table 3. **Number and Percentage of Applicants to Orthopedics Nationally**

Period	Sex, n (%)		Race, n (%)	
	Male	Female	White + Asian	Minority
2002–2006	4083 (86%)	675 (14%)	4006 (84%)	763 (16%)
2007, 2009–2012[a]	3634 (85%)	643 (15%)	4329 (81%)	1002 (19%)

[a]National data from 2008 and national data on sex differences in orthopedic applications from 2009 were not available.

Table 4. **Characteristics of Survey Respondents**

Characteristic	Group	
	Precurriculum	Postcurriculum
N	28	30
Female, n	6	12
Underrepresented minorities, n	0	5

experience. By contrast, 7 postcurriculum students (5 females/minorities) had no prior interest in orthopedics—they chose to pursue the specialty after their orthopedic rotation.

Discussion

Orthopedic surgery needs a more diverse workforce[11-17] in order to better mirror the population served, bring care to underserved areas,[18-26] and provide better training environments.[27] Several hypotheses about the lack of diversity have been posited: stereotypes about the specialty,[28-31] lack of interest among minority medical students, and lack of exposure to the specialty.[5,6,32,33]

Lack of exposure deserves scrutiny, as a large proportion of medical students who choose to apply to orthopedic surgery make their decision before entering medical school, which is not typical.[33] Such a finding suggests that exposure to orthopedic surgery is lacking, especially given that an orthopedic surgery rotation is usually not required during the clinical years. The idea that increased exposure to orthopedics affects application patterns is logical, as clinical exposure has been shown to play a role in medical students' choice of specialty.[34]

Exposure helps in several key areas. Firsthand experience can help dispel stereotypes, such as the idea that success in orthopedic surgery depends on physical strength and that only former athletes pursue orthopedics.[28-31] Authors have also reported on a perceived negative bias against women: Orthopedics is an "old boys' network"; women will not fit in and need not apply; the orthopedic lifestyle is difficult and not conducive to a satisfying personal life.[9] Requiring exposure ensures that all students, but especially women, can gain firsthand experience that can show these stereotypes to be false. Beyond dispelling these stereotypes, exposure to orthopedic surgery is essential for women, as studies have shown that clinical rotations play a larger role in determining specialty choice for women compared to men,[33] and this would be particularly critical for specialties they may not be initially considering.

A national study found that requiring an orthopedic/musculoskeletal clerkship led to a 12% relative increase in the application rate, from 5.1% to 5.7%, and to an increase in applicant diversity (race, sex).[10] However, the investigators could not determine individual reasons for specialty choice or the exact nature of each institution's musculoskeletal curriculum. Confirming these factors, we found an 81% increase in number of female applicants and a 101% increase in number of underrepresented minority applicants after introduction of the required third-year musculoskeletal surgery clerkship at our institution.

We were unable to replicate the 12% relative increase in the overall application rate; our orthopedic surgery match rate remained 6%. Our findings cannot directly explain this, but we have several hypotheses. First, whereas other studies measured the application rate, we measured the successful match rate, given our data structure. This difference in data definition could account for some of the discrepancy. Second, we did not account for individuals' academic success, and career counseling is paramount in decisions regarding residency specialties. It is possible we are substituting qualified female and underrepresented minority candidates for less-than-qualified male applicants. Third, the 25% increase in medical student exposure to orthopedic surgery led to a corresponding increase in number of orthopedic faculty providing undergraduate medical education. Some of these faculty could have been inexperienced in undergraduate medical education, and thus the teaching environment may not have been optimal.

Our study had several limitations. First, our institution has limited racial diversity. Over the past 12 years, only 15% of our students have been underrepresented minorities. (Nationally, the proportion is closer to 18%.) This may have limited the ability of our orthopedic rotation to affect the proportion of underrepresented minority applicants. Second, this study involved medical students at only one institution, which limits generalizability of findings. Third, we were unable to obtain records specifying which faculty and residents interacted with which medical students, and the increased number of female faculty and residents coinciding with the curriculum change may also be a factor. However, we expect that, without the curriculum change, these students would have had smaller odds of interacting with these potential female role models in orthopedics, negating any affect they may have had. Last, although we contacted former students to ask about their reasons for choosing the orthopedics residency, those findings are limited by a potential respondent selection bias.

The qualities and characteristics of successful orthopedic surgeons, as presented in both medical and lay cultures, are subject to numerous stereotypes. By increasing medical student exposure to orthopedics during the third year of medical school, we are giving a larger proportion of our

students direct clinical experience in a field they may not have been considering. This exposure allows students to interact with mentors who can be positive role models—orthopedic surgeons who are dispelling stereotypes. By increasing medical student exposure and reaching students who may not have been considering orthopedics, we have increased diversity among our applicants. Third-year medical students' exposure to orthopedic surgery is essential in promoting a more diverse workforce.

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