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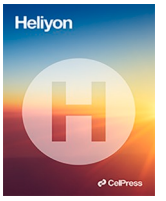

Research article

The impact of surgical elective exposure during medical school upon residency match rates

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ABSTRACT

Objective: This study aims to investigate potential differences in surgical subspecialty match rates between medical schools with and without elective rotations in the respective surgical subspecialties.

Design: Data on duration of surgical rotations were retrieved from each school's public website. Fisher exact tests were performed to identify any statistically significant differences in surgical specialty match rates by allopathic versus osteopathic and elective clinical exposure. A linear regression was performed to determine the correlation between number of surgical electives offered and proportion of students matching in any surgical subspecialty.

Results: The number of surgical electives offered by allopathic medical schools positively correlated with the proportion of students matching in any surgical specialty ($R^2 = 0.038$, $p = 0.018$). Elective rotations in surgical subspecialties were associated with higher match rates in ophthalmology (OR 1.864, 95 % CI 1.196, 3.059, $p < 0.01$) and plastic surgery (OR 2.543, CI 95 % 1.061, 7.972, $p < 0.05$)

Conclusion: There are significant differences in match distribution between allopathic and osteopathic medical schools for surgical subspecialties. This may be due to differences in clinical exposure to these specialties offered to students at their respective medical schools. Medical schools can support students' successful match into competitive surgical subspecialties by increasing students' exposure through elective rotations.

1. Introduction

The process of choosing a medical specialty is no small task. A multitude of factors influence medical students' decisions to pursue different specialties. Given the increasing competitiveness of residency applications in recent years, academic performance and USMLE board exam scores are frequently cited by medical students as considerations when choosing a specialty. Other commonly cited considerations include lifestyle (i.e., work/life balance) and earning potential [1,2]. However, perhaps the most influential factor when deciding to pursue a medical specialty is clinical exposure [1,3].

Clinical training in medical school involves rotating through clerkships in a variety of medical specialties. A vast majority of this training consists of required, or "core", clerkships, with relatively little time allotted for clinical experiences in medical specialties outside of the required curriculum. The required clinical curriculum in most medical schools encompasses only six or seven of the 29

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medical specialties which students may pursue via residency application. This discrepancy makes it difficult for students to gain exposure in potential fields of interest, particularly in surgical subspecialties. Previous studies have demonstrated the influence of clinical exposure on medical specialty choice amongst prospective applicants [1,4]. However, few, if any, studies have examined the relationship between availability of elective clinical exposure to surgical subspecialties in the medical school curriculum and the subsequent residency match rates in these fields. This study aims to investigate potential differences in surgical subspecialty match rates between medical schools with and without elective rotations in the respective surgical subspecialties.

2. Material and methods

This retrospective cross-sectional study was conducted from June to September 2022. A list of 155 allopathic and 43 osteopathic medical school programs in the United States was compiled using publicly available information from the Association for American Medical Colleges (AAMC) and the American Association of Colleges of Osteopathic Medicine (AACOM), respectively. Data on duration of required surgical rotations, elective surgical specialty rotations, and recent match information (2019–2022) were retrieved from each school's public website. Schools that did not provide publicly available website information on curriculum and/or match rates were contacted via email; those that did not respond to email inquiries regarding these data were excluded from the study. Non-categorical matches (i.e, preliminary and transitional) were excluded from analysis, as the goal of this study was to identify specialty-specific matches. This study analyzed elective exposure to the surgical specialties represented in the National Resident Matching Program (NRMP).

Descriptive analysis was performed to identify the most common elective surgical rotations, average duration of the experiences, and most frequently matched surgical specialties. Allopathic and osteopathic medical schools were analyzed independently and combined. Fisher exact tests were performed to identify any statistically significant differences in surgical specialty match rates by: 1) school type (allopathic versus osteopathic), and 2) elective clinical exposure. Statistical significance was set at $p \leq 0.05$. A linear regression analysis was performed to determine if there existed a correlation between number of surgical electives offered and proportion of students matching in any surgical subspecialty. All statistical analyses were performed using R Studio Version 4.2.1.

Institutional review board (IRB) approval was not required for this study, as all information was collected using publicly available resources.

3. Results

155/198 (78.3 %) of medical schools, of which 121 were allopathic and 34 were osteopathic, were included in our study. The duration of required surgery rotations averaged seven weeks at allopathic schools and six weeks at osteopathic schools. Electives in surgical subspecialties ranged from 2 to 4 weeks of the overall rotation duration.

Surgical subspecialty clinical electives most commonly offered and with most students matching in allopathic and osteopathic medical schools included Orthopedic Surgery (OR 2.099, 95 % CI 1.708, 2.599, $p < 0.00001$), Ophthalmology (OR 7.899, 95 % CI 4.981, 13.278, $p < 0.00001$), Otolaryngology (OR 5.537, 95 % CI 3.512, 9.213, $p < 0.00001$), Urology (OR 4.442, 95 % CI 2.918, 7.063, $p < 0.00001$), Neurosurgery (OR 9.489, 95 % CI 4.501, 23.971, $p < 0.00001$), Plastic Surgery (OR 298.029, 95 % CI 80.820, 2548.431, $p < 0.00001$), and Vascular Surgery (OR 10.669, 95 % CI 2.812, 90.385, $p < 0.00001$) (Table 1). Surgical match rates were significantly higher in allopathic medical schools when compared to osteopathic medical schools for all of the above surgical subspecialties. The number of surgical electives offered by allopathic medical schools positively correlated with the proportion of students matching in any surgical specialty (Fig. 1, $R^2 = 0.038$, $p = 0.018$).

Elective rotations in surgical subspecialties were associated with significantly higher match rates in two different fields, ophthalmology (OR 1.864, 95 % CI 1.196, 3.059, $p < 0.01$) and plastic surgery (OR 2.543, CI 95 % 1.061, 7.972, $p < 0.05$) (Table 2). Osteopathic medical schools were excluded from this portion of analysis due to their significantly lower match rates in surgical specialties compared to allopathic medical schools.

Table 1
Match rate for MD and DO students.

Specialty	Mean MD Match Rate	Mean DO Match Rate	Odds Ratio	95 % CI	p-value
Neurosurgery	0.023	0.019	9.489	4.501, 23.971	<0.001[a]
Orthopedic Surgery	0.011	0.004	2.099	1.708, 2.599	<0.001[a]
Ophthalmology	0.011	0.004	7.899	4.981, 13.278	<0.001[a]
Otolaryngology	0.005	0.001	5.537	3.512, 9.213	<0.001[a]
Plastic Surgery	0.014	0.004	298.029	80.820, 2548.431	<0.001[a]
Urology	0.006	0.001	4.442	2.918, 7.063	<0.001[a]
Vascular Surgery	0.002	0.000	10.669	2.812, 90.385	<0.001[a]

Fisher exact tests were conducted between the match rate of MD students and DO students.
MD = Doctor of Medicine; DO = Doctor of Osteopathic Medicine.
[a] p value < 0.001.

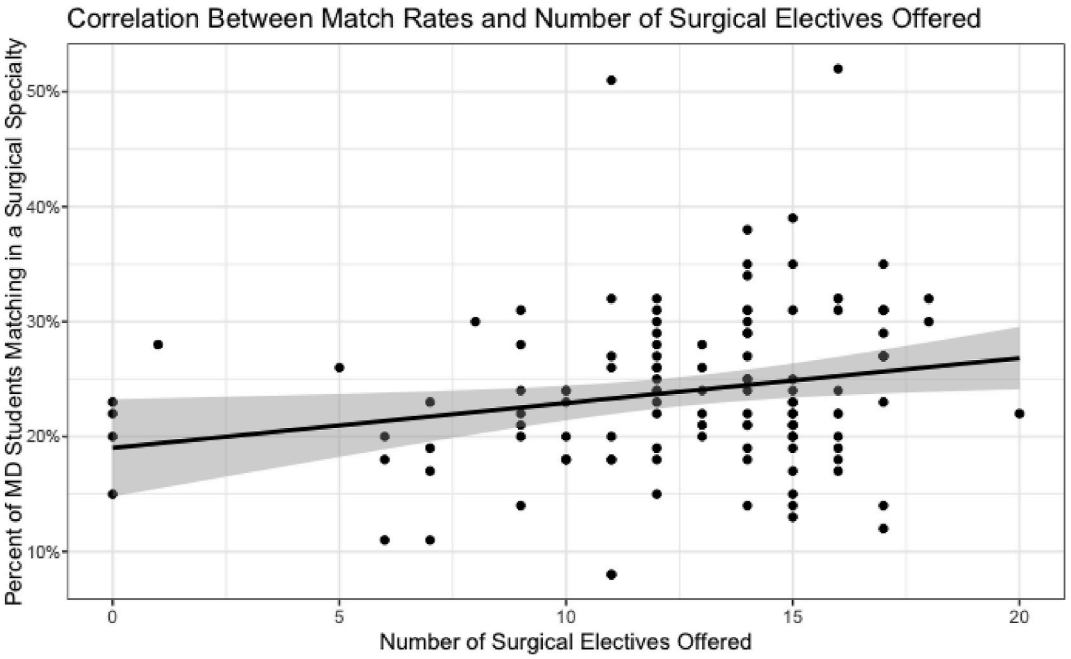

Fig. 1. Linear Regression Between Match Rates and Number of Surgical Electives Offered
R [2] = 0.038, p = 0.018.

Table 2
Match rates for students with and without an offered elective.

Specialty	Mean Percentage Matched With Elective Offered	Mean Percentage Matched Without Elective Offered	Odds Ratio	95 % CI	p-value
Neurosurgery	0.011	0.012	0.918	0.537, 1.686	0.674
Ophthalmology	0.036	0.036	1.864	1.196, 3.059	0.004[a]
Orthopedic Surgery	0.025	0.014	1.008	0.693,1.519	1
Otolaryngology	0.018	0.010	1.826	0.943 4.050	0.088
Plastic Surgery	0.010	0.004	2.543	1.061, 7.972	0.032[a]
Urology	0.017	0.014	1.233	0.730, 2.244	0.540
Vascular Surgery	0.004	0.002	1.669	0.827, 3.723	0.169

Fisher exact tests were conducted between the match rates of students who were offered the elective and students who were not offered the elective.
[a] p value < 0.05.

4. Discussion

Medical education in the United States currently includes at least one full year of clinical rotations prior to the beginning of the residency application cycle. However, students with an interest in surgical subspecialties may find it difficult to gain sufficient exposure to these specialties while completing their clinical curriculum and prior to the residency application cycle. This challenge, combined with the ever-increasing competitiveness of successfully matching into surgical subspecialties, creates a barrier for students who attend schools that lack elective exposure opportunities. Previous studies have demonstrated that early exposure, lifestyle expectations, length of training, and role models significantly influence specialty choice [5–9]. Prior studies have also found that simulation and surgical skills trainers, as well as surgical electives during the preclinical years, may promote interest in the surgical field, further underscoring the value of specialty exposure upon residency selection [4,5,10,11].

When evaluating surgical subspecialties, we found medical schools offering elective rotations in plastic surgery and ophthalmology had significantly higher match rates than those without these elective experiences. This may be because these two specialties are highly competitive [12,13]. Due to this competitiveness, students without adequate exposure to the field will undoubtedly have increased difficulty to gain a foothold in the field. Ensuring more exposure opportunities to these surgical subspecialties can allow students to be better prepared for residency as well as having easier access to high quality mentors.

There were significant differences in the match rates between allopathic and osteopathic schools, which may be attributed to differences in available elective rotations. Osteopathic and allopathic medical schools do have similar curricula; however, osteopathic medicine also includes education about osteopathic manipulative medicine. This highlights the need to increase the availability of

elective experiences at schools that may be lacking such rotations.

Our findings further demonstrated that a larger number of available surgical electives was directly correlated with a higher proportion of students matching into surgical specialties. However, this linear regression was characterized by a modest R^2, despite being statistically significant This R^2 may be relatively low because of the numerous other variables that also contribute to specialty selection. Specialty exposure is one of many factors that correlates with medical student match; there have been numerous other studies investigating the effects of various other factors upon match rates [1,3,4,6,11].

With an increasing number of medical students applying to surgical specialties, numerous surgical fields report greater proportions of unmatched applicants [14,15]. The present study examines the impact that available elective rotations have on matching into surgical subspecialties. However, medical students at schools that do not offer such elective experiences may be at a disadvantage compared to their peers at schools that offer specific surgical electives. Students without available elective rotations in their specialty of interest may benefit from participating in away rotations and sub-internships during their fourth year of medical school.

The impact of doing an away rotation on the surgical program in which the applicant matched varied with the surgical specialty to which applicants were applying. In plastic surgery (integrated), performance on away rotations was one of the most highly ranked residency selection factors [12]. When evaluating plastic surgery residents of the top 25 programs in 2019, over 45 % completed an away rotation at their current training program [16]. In ophthalmology, participating in away rotations provided a great advantage with interview selection, as over 80 % of program directors reported being more likely to interview a visiting medical student than an equally comparable applicant [13]. In orthopedic surgery, participating in 2 or more away rotations significantly increased match rates compared to students that participated in one or more away rotations [17]. In vascular surgery (integrated), 42 % of applicants matched at an institution where they performed an away rotation during the 2020 application cycle [18]. In neurosurgery, residency programs have considered away rotations an increasingly important factor with the transition of the United States Medical Licensing Exam Step 1 to a pass/fail scoring system [19]. In urology, 98 % of applicants in the 2022 application cycle received interviews at institutions where they performed their away rotation [20]. However, this may have been influenced by guidelines limiting urology applicants to only one away rotation during the 2022 cycle. In otolaryngology, 35 % of applicants matched at an institution in which they performed an away rotation; however, the total number of away rotations performed did not confer a significant advantage in matching into the field [21].

Limitations of the present study are that it is based on the existence of an elective rotation in each specialty and the likelihood of students from those medical schools to match into one of these specialties. A home program is defined as an institution with a residency for the particular specialty. Previous studies have shown that students with a home program are more likely to match into any given specialty [22]. By having a home rotation, one can assume that this makes it easier for an applicant to have access to high quality mentors during their elective rotations, which has been shown to have a strong impact on a student's interest in a specialty and the ultimate likelihood to match into that specialty [22]. It could also mean that having a home rotation makes it more likely that there is an interest group exposing students prior to rotations which has an even stronger likelihood to attract students to that surgical specialty. Future studies should evaluate the impact that home institutions have on promoting exposure to surgical specialties. Furthermore, only 78 % of eligible medical schools were included in our study, since the remaining medical schools did not provide publicly accessible match lists and elective rotation offerings on their websites and they did not respond to our survey requesting these data.

Despite these limitations, there is an abundance of information supporting that exposure to a surgical specialty through clinical clerkships provides students with a higher chance of matching into a given surgical specialty. With the increasing scarcity of surgeons in the United States, medical schools can better address this shortage by providing opportunities for exposure to all surgical specialties to which medical students are eligible to apply upon completion of medical school. The results from this study add to the existing literature on the effects of exposure to specialties during medical school, and also provides potential solutions that can improve the education offered by institutions that provide limited specialty exposure to their students [1,3,4,6,11]. However, medical schools may not have adequate resources to add clerkships in certain surgical specialties to its affiliated teaching hospitals. Therefore, we recommend schools that do not already have access to these surgical specialties partner with nearby medical schools or institutions that do offer clerkships in these specialties. An example of such an initiative is demonstrated by the American Council of Educators in Plastic Surgery (ACEPS), which pairs medical schools that do not have plastic surgery residency programs with institutions within their respective regions that do offer such rotations to provide all medical students with the opportunity to do an elective clerkship in plastic surgery and thereby promote exposure to the specialty [23].

5. Conclusion

There are significant differences in match distribution between allopathic and osteopathic medical schools for surgical subspecialties. This may be due to differences in clinical exposure to these specialties offered to students at their respective medical schools. Medical schools can support students' successful match into competitive surgical subspecialties by increasing students' exposure through elective rotations, as well as shadowing opportunities during the preclinical years. To provide competitive applicants for the surgical specialties, we recommend that medical schools design their curricula to provide opportunities for exposure to all surgical specialties to which medical students are eligible to apply upon completion of medical school.

Data availability statement

The data that support the findings of this study are made publicly available by the Association for American Medical Colleges and

the American Association of Colleges of Osteopathic Medicine. Data on duration of required surgical rotations, elective surgical specialty rotations, and recent match information (2019–2022) were retrieved from each school's public website.

CRediT authorship contribution statement

Umer A. Qureshi: Writing – original draft. **Alice Yau:** Writing – original draft. **Kristof S. Gutowski:** Writing – review & editing. **Taylor G. Hallman:** Writing – review & editing. **Marina A. Lentskevich:** Writing – review & editing. **Narainsai K. Reddy:** Writing – review & editing. **Angie Aguilar:** Writing – original draft, Kathryn Reisner, Writing – review & editing. **Arun K. Gosain:** Writing – review & editing, Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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