Research Article

A Focused Gap Year Program in Orthopaedic Research: An 18-Year Experience

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Abstract

Introduction: Students seek gap years to enhance knowledge and improve chances of professional success. Although many institutions offer research opportunities, no studies have examined outcomes after these experiences. This study evaluates a dedicated year of orthopaedic research on a cohort's ultimate orthopaedic surgery match rate.

Methods: From 2001 to 2018, 129 learners spent a year with our Department of Orthopedic Surgery at a major academic medical center. The students were either completing a gap year after college, during or after medical school, or after an unsuccessful match. Participants were asked to respond to a survey, which included demographics, educational information, and metrics related to the program. For the subcohort of students who ranked orthopaedic surgery, the match rate was compared with the mean for the US orthopaedic surgery match rates from 2006 to 2018 using a chi-square analysis. In addition, a Mann-Whitney *U* test was used to compare the number of publications before and after the year.

Results: One hundred three students (80%) returned completed questionnaires. Of all learners who applied to and ranked orthopaedic surgery, 91% matched into an orthopaedic surgery residency program. These results compared favorably with the US orthopaedic match from 2006 to 2018 (67.9%; $P < 0.001$), despite a 4-point lower United States Medical Licensing Examination (USMLE) Step 1 score for the research cohort. Finally, the research cohort had a greater percentage of women (23%) and minorities (40%) than the proportion of woman and minority practicing orthopaedic surgeons.

Conclusion: Students who completed a *gap year in research* matched into orthopaedics at a higher rate than the national average, despite a lower Step score. Mentors may also target traditionally underrepresented groups to help increase the pool of diverse applicants.

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There are many reasons learners might pursue a gap year. For college graduates, it may allow confirmation in their decision to apply to a medical school and help them gain research experience. Completing a research year between third and fourth year of medical school or after failing to match may help an applicant publish research and obtain letters of recommendations to help them match.

Although the number of applicants participating in the National Resident Matching Program (NRMP) increases

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each year, the match rate has stayed relatively constant across all specialties due to increases in the size of many residency programs.[1] Orthopaedic surgery is among the most competitive specialties within the NRMP with regard to the number of applicants per position.[2] Applicants for orthopaedic surgery recognize the competitive talent pool and often seek opportunities outside their required medical school curriculum to enhance their chances to match. For many students, this includes a research year where they gain experience and complete publications at a rate greater than would be possible in school.

Factors considered important in selecting candidates for orthopaedic residency programs include performance during away rotations, Step scores, clerkship grades, class rank, Alpha Omega Alpha, letters of recommendation, research productivity, medical school ranking, and extracurricular activities.[3] The potential benefit of a gap year in research is that an applicant's research portfolio can be dramatically increased within a short period of time. In addition, a research year provides opportunities to develop relationships with mentors who could provide letters of support.

In 2001, our department was one of the first major academic departments to offer an organized *gap year* research program for students. This study evaluates a cohort of learners who completed a year with our orthopaedic department from 2001 to 2018 and determines the effectiveness of this program.

Methods

Cohort and Survey Data

From 2001 to 2018, 129 learners spent at least 1 year (mean: 1.2 years, range: 1 to 3 years) with our Department of Orthopedic Surgery at a major academic medical center. The programs were organized individually but structured similarly to include research time, clinical shadowing, operating room observation, and participation in academic curriculum including conferences and weekly grand rounds. The divisions included orthopaedic trauma, adult reconstructive surgery, shoulder and elbow, spine, and sports medicine. The students were either completing a gap year after college, during or after medical school, or after an unsuccessful match. Some students were paid during their research year and some voluntary, depending on the division and the year they participated.

After approval of the Institutional Review Board (IRB), surveys were sent to participants through a recruitment e-mail (provided by the student at the end of their experience) which provided a link to a secure, IRB-approved survey site. The survey included questions about demographics, education, and the research program. Surveys were completed between December 24, 2018, and March 24, 2019. All data collected were stored in an IRB-approved database. Demographic and career data not obtained via the survey were obtained from the individual program director.

National Resident Matching Program Data

The NRMP provides annual reports summarizing the Main Residency Match. The reports from 2001 to 2018 were searched for information regarding orthopaedic surgery application volume and matched applicants' Step scores. Reports from 2001 to 2005 did not provide information on the number of applicants, so these years were excluded from the match rate analysis. In addition, Step scores were only available from the *Charting Outcomes in the Match* reports, in which only seven editions have been released (2006, 2007, 2009, 2011, 2014, 2016, and 2018). The average of the Step scores from only those years were used in the analysis. We chose to average all years for the national match rates and Step scores to minimize bias from fluctuating and directional trends (see Supplemental Digital Content 1, Table 1, http://links.lww.com/JAAOS/A411 and Supplemental Digital Content 2, Table 2, http://links.lww.com/JAAOS/A412).

Data Analysis

For the subcohort of students who applied to and ranked orthopaedic surgery residency programs after their research year(s), the match rate was compared with the average of the US orthopaedic surgery match rates from 2006 to 2018 using a chi-square analysis. A chi-square test was also used to compare match rates between students who took 1 year versus those who took more than 1 year and researchers applying to residency for the first time versus after failing to match. In addition, a Mann-Whitney *U* test was used to compare the average number of publications before and after the year. Finally, an independent-samples *t*-test was used to compare the number of publications as a result of 1 versus more than 1 research year. No SDs were provided by the NRMP for Step scores, so no comparison could be made between the two cohorts and their mean Step scores.

None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Egol, Shields, Dr. Errico, Dr. Iorio, Dr. Jazrawi, Dr. Strauss, Dr. Rokito, and Dr. Zuckerman.

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Table 1

Average USMLE Step Scores and Match Rates of the Gap Year Cohort Compared With the National Average for Orthopaedic Surgery

Factor	Average Step 1 Score[a]	Average Step 2 Score[a]	Match Rate
Gap year cohort	236	243	91.0%
National average[b,c]	240	247	67.9%

[a] Average Step scores only apply to those who successfully matched.
[b] National average Step scores apply only to 2006, 2007, 2009, 2011, 2014, 2016, and 2018.
[c] National average of the match rates only apply to 2006–2018.

Results

Of the 129 gap year student researchers, 30 (23%) were female and 99 (77%) were male. In this cohort, the racial breakdown was as follows: 77 (60%) were White, 25 (19%) Asian, 14 (11%) Black or African-American, and 13 (10%) Hispanic or Latino. Thirty-seven (29%) were college graduates, 73 (57%) were current medical students, and 19 (15%) were students or graduates who failed to match. Among all researchers, 51 (40%) completed a year in the division of orthopaedic trauma, 39 (30%) in spine surgery, 18 (14%) in sports medicine, 17 (13%) in adult reconstructive surgery, and 4 (3%) in shoulder and elbow surgery. Either before or after the year, 46 (36%) attended a top 25 medical school, 69 (53%) did not attend a top 25 medical school, 8 (6%) never attended a medical school, and the medical school was unknown for 5 (4%).[4] One hundred three students (80%) completed the survey.

Of the research cohort (college students who went to medical school and ultimately ranked orthopaedic surgery, students between third and fourth year, and those who were unmatched) who eventually ranked orthopaedic surgery programs, 81 (91%) successfully matched and 8 (9%) failed to match (Table 1). This compared favorably with the average US orthopaedic match rates from 2006 to 2018 of 67.9% ($P < 0.001$), despite a 4-point lower Step 1 score (see Supplemental Digital Content 1, Table 1, http://links.lww.com/JAAOS/A411, Supplemental Digital Content 2, Table 2, http://links.lww.com/JAAOS/A412 and Table 1). No difference was noted in match rate for students applying for the first time (92%) versus after failing to match into orthopaedic surgery (89%) ($P = 0.833$). The mean Step 1 and 2 scores were 236/243 for the gap year cohort and 240/247 for the national average cohort (Table 1). No comparison could be made for Step scores because no SD was provided by the NRMP.

Most of them (85%) took 1 research year, 12% took 2 years, and 3% took 3 years. A significant difference was present in the number of publications after taking 1 (8.0 ± 7.0) compared with more than 1 research year (20.8 ± 15.4) ($P < 0.001$). However, no difference existed in orthopaedic surgery match rates for those who took 1 (91%) versus more than 1 year (92%) ($P = 0.833$).

Of those who applied to a residency program of any specialty, 81 (74%) did orthopaedic surgery. The next most common residency was anesthesia, with 11 (10%) selecting this career. The remaining researchers were evenly distributed over nine specialties (see Supplemental Digital Content 3, Table 4, http://links.lww.com/JAAOS/A413). Of all respondents, 91% matched into their top three ranked programs.

Twenty-eight undergraduate researchers (76%) matriculated to medical school after their gap year. The remaining nine (24%) were not accepted or chose a different career (Figure 1). Seven have not yet graduated medical school, but of the 21 who have, 8 (38%) matched into orthopaedic surgery.

Most of the research cohort who matched (73%) went into academic medicine. Of the remaining individuals, 17% entered nonacademic medicine and 10% are either not practicing as physicians or not in medicine.

The mean number of publications that resulted from the year was 9.9 ± 9.7, compared with 1.5 ± 2.4 ($P < 0.001$) before the gap year. Finally, the mean satisfaction was 9.0/10.0 ± 1.6 with an average self-perceived effectiveness of 8.7/10.0 ± 1.0.

Discussion

A gap year in orthopaedic research can provide many benefits, from boosting publications to establishing relationships with mentors. Learners who completed a year at our academic medical center had, on average, 1.5 publications before their year and 9.9 publications as a result. This demonstrates the value of a year in orthopaedic research as a valuable tool in providing resources to enhance scholarly activity and strengthen residency applications. Although students who took more than 1 year produced, on average, 13 more publications than those who took 1 year, no difference was noticed

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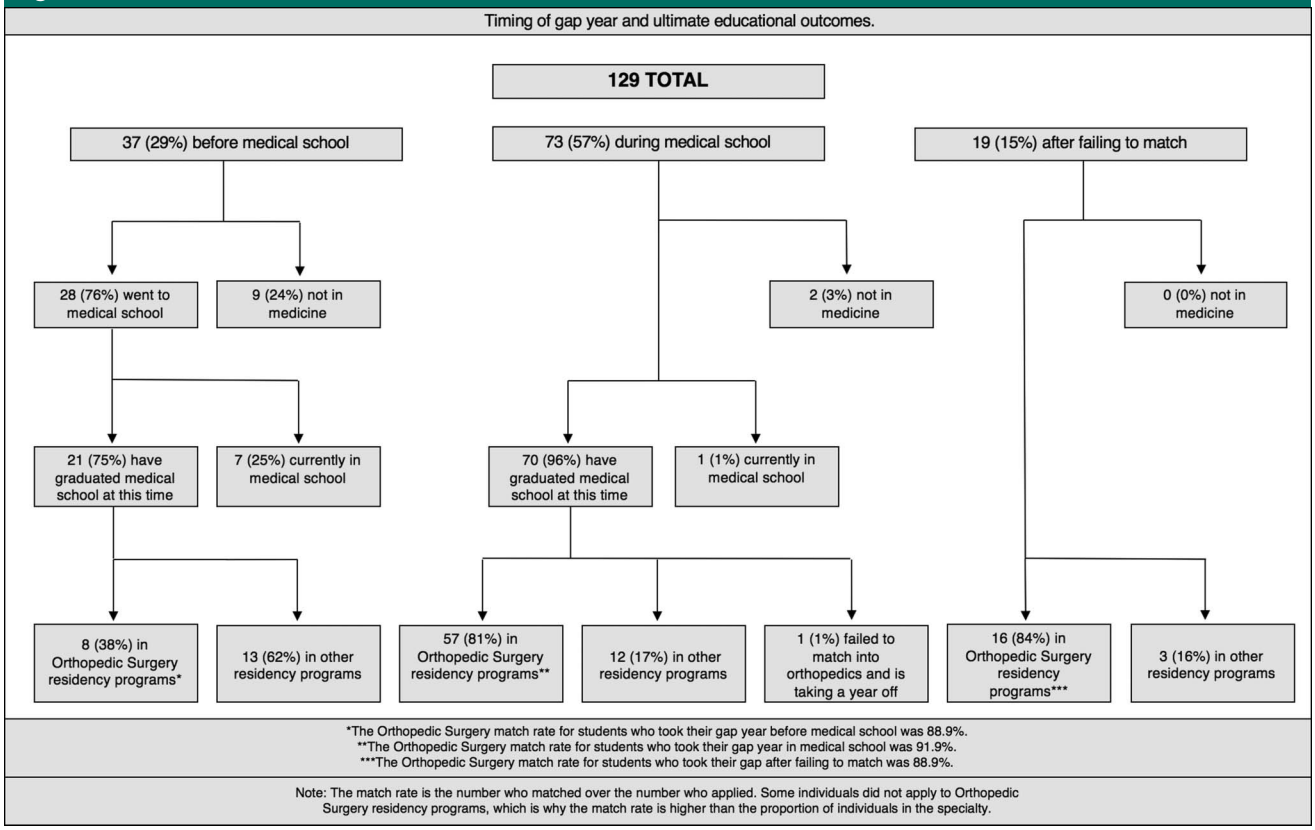
Figure 1



Flowchart displaying the timing when researchers took their gap years and their ultimate educational outcomes.

in match rates to orthopaedic surgery programs.

At our institution, the gap year students matched into orthopaedics at a higher rate than the national average, despite a lower Step score. In addition, no difference existed in match rates between those who applied to orthopaedic surgery for the first time versus after failing to match. The students who completed a year at our institution were ultimately more likely to pursue orthopaedic surgery and academic medicine. On average, the students were satisfied with their year and felt that their time was effective. Overall, this study highlights the value orthopaedic research years have on the ability of students to compensate for application deficiencies.

Of 89 individuals who applied to and ranked orthopaedic surgery residency programs, only 8 failed to match. Looking at these individuals, it is notable that three attended a nonallopathic medical school, two had Step scores lower than 226, and one had a publication output that was much lower than the average for the gap year cohort. The remaining two individuals had no outstanding reasons as to why they did not match. However, an additional reason why applicants may not match includes fit incompatibility with the programs they rotate at. Therefore, there may be factors that are beyond the ability of the research year to make up for with regard to a student's ability to match into an orthopaedic surgery program.

Although NRMP trends demonstrate that the orthopaedic surgery match rate has remained relatively constant over the past decade (see Supplemental Digital Content 1, Table 1, http://links.lww.com/JAAOS/A411), applicants' credentials have improved dramatically, making the match more competitive than previously. One study revealed that the average number of publications, presentations, and abstracts for matched applicants has more than doubled from 2007 to 2014.[5] This suggests that research years are more important than ever. In fact, one survey study concluded that 32% of students complete research years to increase the competitiveness of their application, 24% use the year to pursue other opportunities, and 23% for academic interests.[6] Although research years are highly academic, students primarily complete these years to strengthen their applications.

With regard to applicants who failed to match, one study reported

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that success in re-applying is more dependent on establishing relationships with faculty than other factors.[7] Thus, networking is an additional benefit of the year, especially for students who initially failed to match.

A major benefit of a research year is the mentor-mentee relationship. One study found that students applying for emergency medicine who had an *effective* mentor, as determined by a Mentorship Effectiveness Scale, had a more favorable outcome compared with those who did not.[8] Students who completed a year at our institution were able to work with physicians, some of whom provided advice on applications, which institutions they would benefit from completing away rotations, and in general, a better understanding of what residency programs seek in applicants. This type of mentorship is unique because the researchers have opportunities to work with their mentors on a daily basis for the entire year. In the end, mentorships formed from a gap year can be highly personal and thus even more beneficial to the student's specific goals.

In addition, mentorships have the ability to shape the future of orthopaedics, particularly by increasing diversity. In 2016, women made up 6.5% of orthopaedic physicians.[9] However, this number has been increasing, and in the 2016 to 2017 match year, 14.2% of orthopaedic residents were female.[10] In addition, underrepresented minorities, including Hispanics/Latinos, African-Americans, and Asian-Americans, made up only 20.7% of orthopaedic residents.[11] In this program, 23.3% of researchers were female and 40.3% were minorities. Although we cannot determine the sex or the underrepresented in medicine (URiM) match rates for non–gap year students, we can compare our results with the current proportions of woman (6.5%) and minorities (9.9%) who participated in the 2016 American Academy of Orthopaedic Surgeons census.[9] Medical centers that offer research opportunities may contribute to decreasing the sex gap and increasing minorities in orthopaedics.

Previous studies in plastic surgery have demonstrated that students who completed a gap year matched into plastic surgery at a higher rate than the national average.[12] These results are consistent with our study and provide further support that gap years can be effective in enhancing residency applications.

Acceptance to medical school has become increasingly selective. In 2018, 52,777 students applied to medical school and 21,622 matriculated, for a matriculation rate of 41.0%.[13] Completing a research year before medical school may be advantageous for applicants by reporting the position on their American Medical College Application Service (AMCAS) application and using it as talking points during interviews. In addition, for students who are unsure whether they want to pursue medicine, a medical-based gap year may help in making the decision. Finally, publishing in the peer-reviewed literature before medical school would also benefit participants in the future as they apply to residency.

These results represent an experience in a research program at one large academic institution, so they are not representative of students who have completed programs at other institutions. Another limitation is the lack of data on national United States Medical Licensing Examination (USMLE) Step scores and match rates. The NRMP provides these data for some but not all years. Thus, the calculated average Step scores and match rates could be skewed from not having every year included. We do not know when specifically students matched. It could have been immediately after the gap year or at a later time, so it is not possible to do a year-by-year comparison of our internal match rate with the NRMP match rate or report the annual mean Step score for the gap year cohort. Regarding Supplemental Digital Content 2 (Table 2, http://links.lww.com/JAAOS/A412), we could only provide mean Step scores for US seniors, not total number of applicants, because the NRMP does not provide this information.

A few other limitations may have affected the results of this study. First, the survey did not ask why some of the college graduates did not attend medical school, so we cannot say for sure whether these students were denied admission or voluntarily chose a different career path. Second, we were unable to compare female and minority match rates with the national average for these subgroups due to lack of publicly available data. Third, medical school match rates vary between institutions. Although medical schools publicly post the number of students who got into certain specialties, they do not reveal their internal match rates for each specialty, so we were unable to compare this cohort's match rate with their medical school's internal match rate. Fourth, the survey yielded an 80% response rate, which is a potential source of response bias depending on underlying reasons as to why some filled out the survey and some chose not to. Finally, although it is evident that an orthopaedic-based gap year can aid applicants in their pursuits of orthopaedic surgery residency training, it may also be beneficial in other aspects of their career. However, we did not collect data on the gap year's effect on the participant's medical practice beyond residency, and thus, we did not analyze fellowship matching, job search, academic promotions, and grant awards. Future studies beyond the scope of this particular one could examine these topics to further enhance our understanding of the long-term benefit of a gap year.

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Conclusion

Completing a gap year between college and medical school, during medical school, or after failing to match into orthopaedic surgery can benefit both the learner and the program.

This type of experience increases a student's chance of achieving their goal of matriculating to medical school or matching into orthopaedic surgery. A secondary benefit of a gap year is the opportunity to work with academic physicians. These relationships provide many advantages, such as exposure to academic medicine, obtaining meaningful letters of recommendation from within the field, and networking. Ultimately, students who completed a year at our institution were exposed to all elements of orthopaedics at an earlier point in their careers and matched to orthopaedic surgery residency programs at a higher rate than the national average, despite lower Step scores.

On the program side, departments who have the means can provide educational opportunities to minority and female students who take a gap year in orthopaedic research. Finally, the program may benefit from the *development* of future orthopaedic talent for their own training programs, as we have been able to do.

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