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Evaluating the Importance of Sub-Internships on the 2022 Integrated Plastic Surgery Match During Continued COVID-19 Regulations

Lauren M. Sinik, MD,* Katie G. Egan, MD, * Alexis K. Bagwell, MD, MS,† Allison C. Nauta, MD, FACS, † and James A. Butterworth, MBBCh, FACS†.

*Department of Plastic Surgery, University of Kansas Medical Center, Kansas City, Kansas; and †Division of Plastic Surgery, Department of Surgery, Oregon Health and Science University, Portland, Oregon

OBJECTIVE: Following the 2021 integrated plastic surgery match, we found a significant increase in home match rates and decrease in match rate for students without a home plastic surgery program with the elimination of visiting sub-internships and the initiation of virtual interviewing. With the return of visiting sub-internships in the 2022 match cycle, we hypothesize that these rates will approach values more consistent with historical controls.

DESIGN: Program match data was obtained from posts to residency program Instagram pages and posts associated with the hashtag #PRSMatch2022. Data on visiting sub-internship matches was obtained from a publicly available Google Sheet with applicant contributors. The Chi square test was used to assess for differences.

SETTING: Medical schools and plastic surgery programs were categorized into west, midwest, south, and northeast regions.

PARTICIPANTS: Matched applicants to integrated plastic surgery residency programs.

RESULTS: In total, 192 of 194 (99%) of applicants matched to integrated plastic surgery residency positions were identified. The match rate for applicants without an affiliated plastic surgery program (31.3%) increased from 2021 (p = 0.03) and returned to a level consistent with historical controls (p = 0.38). Similarly, the home program match rate (15.1%) and match rate for applicants from Top 40 medical schools (34.2%) decreased from 2021, returning to pre-pandemic levels (p = 0.63, p = 0.12). Finally, regional match preferences remained generally consistent with historical controls, apart from a higher proportion of northeast applicants matching to programs in the northeast (72.5%, p = 0.04), and a lower proportion of west applicants matching to programs in the west (26.3%, p = 0.002).

CONCLUSIONS: The 2022 integrated plastic surgery match cycle saw a reversal of many of the changes to match rates seen in the 2021 cycle. These changes may be due to the reintroduction of visiting sub-internships following updates in COVID-19 policies. (J Surg Ed 79:1435–1440. © 2022 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: COVID-19, integrated plastic surgery, plastic surgery match, medical student match, coronavirus

COMPETENCIES: Professionalism, Interpersonal and Communication Skills, Practice-Based Learning and Improvement

INTRODUCTION

The 2021 National Residency Matching Program (NRMP) cycle was unprecedented due to the implications of the Coronavirus Disease 2019 Pandemic (COVID-19) on both visiting sub-internship and interview guidelines. Integrated plastic surgery residency positions are some of the most competitive in the match, with in-person sub-internships historically playing a substantial role in the match process. Following the elimination of visiting sub-internship opportunities and the initiation of virtual
interviews for the 2021 match cycle, our prior study found subsequent increased home program match rates, decreased match rates for students without a home plastic surgery program, and increased representation of medical students from Top 40 medical schools based on the US News and World Report Medical School Rankings for Research. Overall, the integrated plastic surgery match remained highly competitive with a match rate of 55.3%, according to 2022 NRMP Advance Data Tables. Our findings were reinforced by multiple studies published following the 2021 plastic surgery match cycle, all supporting the conclusion that with changing interview structures and eliminating away sub-internships, rates of medical students matching at home institutions were significantly higher.

For the 2022 NRMP cycle, interviews remained virtual, but policies on visiting sub-internships were updated from the previous year’s restrictions. The Coalition for Physician Accountability’s Work Group on Medical Students Moving Across Institutions for Post Graduate Training published recommendations in April 2021 allowing the resumption of in-person away rotations beginning in July 2021 with an encouraged limit of 1 rotation per learner per specialty. Exceptions to the 1 rotation limit were made in cases where additional rotations were needed to complete graduation requirements. The American Council of Academic Plastic Surgeons (ACAPS) chose not to implement a formal policy on away rotations for the 2022 match cycle, but encouraged adherence to national recommendations and institutional policies based on the uniqueness of the specialty and the variability in access to plastic surgery education across medical schools. Given this policy, integrated plastic surgery applicants had varying levels of in-person access to programs of interest, but this access was still limited compared to match cycles prior to 2021 due to recommendations to limit sub-internships and the virtual nature of interviews.

Historically, a large percentage of integrated plastic surgery applicants who successfully match do so at a program where they have rotated, including both home programs and institutions where they have completed a visiting sub-internship. As previously discussed, we found that the home program match rate in 2021 was 24%, a significant increase from a historical cohort from 2011 to 2015 with a home program match rate of 15%. Historical rates of matching at a program where an applicant has completed an away rotation range from 27% to 33%. We hypothesize that with updates to visiting sub-internship policies from the 2021 match cycle to the 2022 match cycle, there will be a decrease from the home match rate of 24% found in 2021, but this rate will remain higher than historical controls due to continued virtual interviewing and limitations on visiting sub-internships.

**MATERIALS AND METHODS**

The methods used by our group to obtain plastic surgery match data have been described previously in our publication of 2021 integrated plastic surgery match outcomes. Briefly, we again utilized the social media platform Instagram and evaluated posts and stories from integrated plastic surgery residencies to obtain program match data. Applicant posts and stories publicly shared using the #PRSMatch2022 were also evaluated. Applicant medical schools were recorded when available from posts or Instagram accounts.

Medical schools were classified as either home program or non-home program match. Medical schools were categorized by region and compared to match program region. An updated list of accredited integrated plastic surgery programs for 2022 was compiled from the Accreditation Council for Graduate Medical Education (ACGME) website. Applicants who successfully matched from a medical school with an associated plastic surgery residency program or from a 2022 Top 40 US News and World Report Medical School Rankings for Research and National Institute of Health funding were recorded. Self-reported visiting sub-internship data was obtained from a publicly available online database, Google Sheets.

Statistical analysis was performed using Microsoft Excel version 16.46 with Measuring Usability LLC plugin software. Differences between groups were assessed using Chi square test for categorical variables. p-values of less than 0.05 were considered statistically significant.

**RESULTS**

A total of 192 applicants were identified of 194 filled integrated plastic surgery residency positions (99%) from the 2022 match. On review of the NRMP advanced data tables, the 2 applicants who were unaccounted for were both international applicants. Of the applicants identified, 126 (65.6%) were from a medical school with an associated integrated plastic surgery program and 5 (2.6%) with an independent residency program. Comparatively, 60 (31.3%) of applicants were from medical schools without an associated residency program. The match rate for medical students without an affiliated plastic surgery program was increased from 2021 (p = 0.03) and similar to pre-pandemic levels.
TABLE 1. 2022 Match Results Compared to Historical Controls

|                                | 2022 Match Data | 2021 Match Data | Historical Control | p-value* |
|--------------------------------|-----------------|-----------------|--------------------|----------|
| Home program match rate        | n (%)           | n (%)           | n (%)              | p = 0.63 |
| Visiting sub-internship        | 29 (15.1)       | 44 (24.3)       | 253 (19.7)*        |          |
| Affiliated plastic surgery program | 126 (67.7)     | 135 (76.7)      | 80 (69.5)*         | p = 0.38 |
| Top 40 medical school          | 67 (34.2)       | 79 (43.6)       | 374 (40.9)*        | p = 0.12 |
| Northeast regional match rate  | 31 (20.8)       | 31 (18.8)       | 233 (22.2)*        | p = 0.04*|
| South regional match rate      | 28 (17.2)       | 31 (18.8)       | 189 (18.4)*        | p = 0.18 |
| West regional match rate       | 10 (6.2)        | 16 (9.5)        | 64 (6.2)*          | p = 0.002*|

*p-values compare 2022 data to historical controls; * denotes statistical significance

(\(p = 0.38\)). \(^1\)\(^,\)\(^12\) See Table 1 for comparison data between 2022, 2021, and historic controls.

The trend of increased home program match rate from the 2021 match was reversed in the 2022 match, with 15.1% of medical students (29/192) matching at the integrated residency program associated with their home program. \(^1\) The home match rate seen this year is comparable to pre-pandemic data (\(p = 0.63\)). \(^1\)\(^,\)\(^16\) Self-reported visiting sub-internship data was identified for an additional 71 applicants. This data was combined with the known 29 home program matches identified via Instagram posts to total a group of 100 applicants for whom we could determine in-person exposure to a program prior to the match. Extrapolating from this data, 32% (32/100) of applicants reported participating in a visiting sub-internship at the institution where they matched. The visiting sub-internship match rate is also reflective of pre-pandemic data (\(p = 0.61\)). \(^1\)\(^,\)\(^12\)

Eighty-six integrated plastic surgery residency programs participated in the 2022 match; 36 (41.9%) programs are affiliated with a US News and World Report Top 40 medical school. In contrast to the 2021 match, medical students matching from Top 40 medical schools were underrepresented this year, with 67 (34.2%) successfully matching, though this rate was comparable to historical controls. Similar to previous years, applicants from Top 40 medical schools were statistically more likely to match at Top 40 programs (46.5%, 47/101) compared to non-Top 40 programs (22.4%, 20/91). Likewise, non-Top 40 applicants were more likely to match at non-Top 40 programs (78%, 71/91) compared to Top 40 programs (53.5%, 54/101; \(p < 0.001\)) Figure 1.

There was a net increase of 2 programs in the south region in the 2022 match, with all other regions having a net even number of programs. Similar to 2021 and pre-pandemic data, the largest representation of medical student matches in the midwest, northeast, and south were from the same medical school region. When comparing the regional match rate to historical controls, there was a statistically significant increase in the regional match rate in the northeast (\(p = 0.04\)) and west (\(p = 0.002\)) of applicants matching in the west region compared to previous years. The subset of international applicants was most likely to match at a program in the midwest region (5/8) and least likely to match at a program in the south (0/8). See Table 2 for regional match data.

CONCLUSIONS

Integrated plastic surgery residency positions remained some of the most competitive in the NRMP match in 2022, with a total of 351 applicants for 194 positions. \(^2\) While the match cycle continued to be affected by the COVID-19 pandemic, the 2022 integrated plastic surgery match cycle differed from the 2021 cycle as visiting sub-internships were permitted to resume on a limited basis. Following this change, we found a decrease in the home program match rate and an increase in the match rate for applicants from institutions without affiliated plastic surgery programs when compared to the 2021 match cycle. These numbers were normalized, to rates consistent with historical controls. \(^1\)\(^,\)\(^10\)\(^,\)\(^12\) These findings suggest that in-person exposure to programs in the form of visiting sub-internships both facilitates applicants...
matching outside of their home institution and also aids applicants without home programs in successfully matching.

While match results from the 2022 match cycle were more consistent with historical controls than the 2021 match cycle, the COVID-19 pandemic continued to play a significant role in the application process as interviews remained virtual for a second cycle. Additionally, The Coalition for Physician Accountability’s Work Group set forth guidelines to limit the number of sub-internships to 1 per student per specialty. Historically, plastic surgery applicants completed an average of 2 to 4 visiting sub-internships during an application cycle, incurring significant expenses, previously estimated by Drolet et al. to be an average of $3591 per applicant. Interestingly, rates of matching at an institution where an applicant completed a visiting sub-internship in 2022 stayed consistent with historical controls, with 32% of applicants matching at an institution where they rotated in 2022 compared to 29% historically.

Assuming that The Coalition for Physician Accountability’s Work Group guidelines resulted in a reduction in the number of total sub-internships completed in 2022 compared to historical match cycles, our results suggest that there are similar home program match rates, visiting sub-internship program match rates, match rates of students without affiliated plastic surgery programs, and geographical match rates with a reduction in visiting sub-internships, as long as these sub-internships are not eliminated entirely as they were in 2021. These results suggest that setting limits on visiting sub-internships may result in a cost decrease to applicants while not significantly impacting overall match results. Due to the competitive nature of the integrated plastic surgery match, students may feel pressure to complete as many visiting sub-internships as their schedule will allow despite a significant financial burden. Setting a reasonable limit on away rotations will allow applicants in-person exposure to programs and an opportunity to network and obtain letters of recommendation without forcing students to choose between taking on more expenses or risking being a less competitive applicant.

### TABLE 2. Integrated Plastic Surgery Applicant Match Data for Each Region

| MW Program | NE Program | S Program | W Program |
|------------|------------|-----------|-----------|
| MW applicant | n (%) | n (%) | n (%) | n (%) |
| NE applicant | 7 (14.5) | 37 (72.5) | 8 (15.1) | 11 (28.9) |
| S applicant | 12 (25.0) | 7 (13.7) | 28 (52.8) | 10 (26.3) |
| W applicant | 2 (4.2) | 3 (5.9) | 4 (7.5) | 10 (26.3) |
| Int applicant | 5 (10.4) | 1 (2.0) | 0 | 2 (5.3) |

MW, Midwest; NE, Northeast; S, South; W, West; Int, International.
Another notable change from the 2021 plastic surgery match to the 2022 cycle was the match rate for applicants from Top 40 medical schools. In the 2021 match cycle, we found a statistically significant increase in the match rate of applicants from Top 40 medical schools compared to historical controls. This rate decreased in 2022, back to a level consistent with pre-pandemic cycles. This result suggests that being an applicant from a Top 40 medical school confers an advantage when applicants are unable to complete visiting rotations. One explanation for this advantage could be that in lieu of letters of recommendation from faculty at visiting sub-internship institutions, programs may put more weight on the perceived prestige of an applicant’s medical school as an indicator of their “competitiveness.” This may result in an overrepresentation of medical students from Top 40 medical schools. Visiting sub-internships likely represent an opportunity for medical students from schools with less perceived prestige to be evaluated on their performance and obtain letters of recommendation, helping to increase their chance of matching. This benefit of visiting sub-internships may also help explain the increase in the match rate for applicants from institutions without affiliated plastic surgery programs from the 2021 match cycle to the 2022 match cycle.

Historically, matches into integrated plastic surgery match tend to favor regional preferences, with programs in a particular region matching the highest proportion of applicants from medical schools in that same region. This remained true in the 2022 match cycle for the midwest, northeast, and south regions. The northeast region saw a statistically significant increase in the proportion of northeast matches when compared to historical controls, as 73% of applicants who matched into northeast programs were from medical schools within the region. The west, however, saw a statistically significant decrease in their regional match rate when compared with historical controls. The highest proportion of matches into programs in the west were applicants from the northeast, with applicants from the south and the west representing equal proportions of matches into the west. This is likely due in part to the fact that the northeast region had the highest number of matched applicants this year with the second highest number of programs, while the west region has the fewest number of programs and the fewest matched applicants. This year, there were more matched applicants from the northeast than there were spots at programs in the northeast. In contrast, there were fewer matched applicants from the west than spots available at west programs. This discrepancy in number of applicants may have overshadowed historical geographic preferences. Reasons for geographic preferences in the plastic surgery match remain largely unknown, but likely stem from both applicants and programs. Applicants may be motivated by familiarity with a given region, proximity to family or friends, financial impact of moving out of a region, and location of professional networks. Programs receive high numbers of applications for very limited positions and may consider the medical school region or regional ties of an applicant as a surrogate marker of how likely the applicant is to be seriously interested in coming to the program.

While this study provides a comprehensive evaluation of the 2022 integrated plastic surgery match cycle in comparison to both the 2021 integrated plastic surgery match cycle as well as historical controls, limitations should be noted. By collecting our data through publicly available platforms including Instagram and Google Sheets, we were afforded the ability to obtain public and self-reported data from programs and applicants on over 99% of matched applicants; however, data is limited by the accuracy of reporting. Additionally, outcomes are limited to correlations and not causation as we did not survey applicants or programs to assess their experience with the return of visiting sub-internships in a more limited way or their overall impressions of the match cycle compared to prior years.

In conclusion, the 2022 integrated plastic surgery match cycle saw match results more consistent with historical controls than the 2021 cycle with the reintroduction of visiting sub-internships on a limited basis. We observed a significant decrease in the home program match rate, a decrease in the match rate of applicants from Top 40 medical schools, and an increase in the match rate for applicants from medical schools without an affiliated plastic surgery program from the 2021 cycle to the 2022 cycle, returning these rates to values statistically unchanged from pre-pandemic controls. As visiting sub-internships were resumed with a recommendation of one rotation per applicant per specialty, match rates at institutions where a student completed a rotation remained the same as historical controls, when there were no recommended limits on number of rotations. All these findings suggest that visiting sub-internships play a vital role in the integrated plastic surgery match process, even in a reduced capacity.

REFERENCES

1. Egan KG, Nauta A, Butterworth JA. Effect of COVID-19 restrictions on 2021 integrated plastic surgery match outcomes. J Surg Educ. 2022;79:249–252. https://doi.org/10.1016/j.jsurg.2021.06.016.

2. Advance data tables 2022 main residency match®. www.nrmp.org. 2022 https://www.nrmp.org/wp-
3. Asadourian PA, Murphy AI, Marano AA, Rohde CH, Wu JK. Home field advantage: assessing the geographic trends of the plastic surgery residency match during the COVID-19 pandemic. *J Surg Educ.* 2021;78:1923–1929. https://doi.org/10.1016/j.jsurg.2021.06.002.

4. Faletsky A, Zitkovsky H, Guo L. The impact of COVID-19 on plastic surgery home program match rates. *Ann Plast Surg.* 2022;88:4–6. https://doi.org/10.1097/SAP.0000000000002981.

5. Faletsky A, Zitkovsky H, Guo L. Disparate responses in match outcome across competitive surgical subspecialties to pandemic era constraints: an analysis of impacts of minimal auditions. *J Surg Educ.* 2022;79:243–248. https://doi.org/10.1016/j.jsurg.2021.07.011.

6. Hollins AW, Zhang GX, Stoehr JR, et al. Staying close to home: the effects of COVID-19 on the plastic surgery residency match. *Plastic Reconstr Surg - Global Open.* 2021;9:e3864. https://doi.org/10.1097/GOX.0000000000003864.

7. Egan KG, Nauta A, Butterworth JA. COVID-19 effects on 2021 home program match rates at integrated plastic surgery programs. *Plastic Reconstr Surg.* 2022;149:369e. https://doi.org/10.1097/PRS.0000000000008746.

8. Updated recommendations on away rotations for medical education institutions of LCME®-Accredited, U.S. Osteopathic, and Non-U.S. medical school applicants work group on medical students moving across institutions for post graduate training.; 2021. http://www.aamc.org/media/52326/download?attachment

9. 2021-2022 match process FAQs. American council of academic plastic surgeons 2022. http://acaplasticsurgeons.org/Resources/match-faaq.cgi

10. Silvestre J, Lin IC, Serletti JM, Chang B. Geographic trends in the plastic surgery match. *J Surg Educ.* 2016;73:270–274. https://doi.org/10.1016/j.jsurg.2015.10.015.

11. Wood JS, David LR. Outcome analysis of factors impacting the plastic surgery match. *Ann Plast Surg.* 2010;64:770–774. https://doi.org/10.1097/SAP.0b013e5181b4bcf5.

12. Kling RE, Kling RR, Agi C, Toirac A, Manders EK. A closer look at the 2013 to 2014 integrated plastic surgery match. *Plast Reconstr Surg.* 2016;137:624e–629e. https://doi.org/10.1097/01.PRS.0000475824.09531.21.

13. The regions of the United States, 2022. https://www.worldatlas.com/articles/the-regions-of-the-united-states.html

14. Maricevich R, Lin SJ, Eberlin KR, et al. Program number /name plastic surgery-integrated programs. 2022.

15. United States news and world report medical school rankings for research. *US News World Rep.* 2022 https://www.usnews.com/best-graduate-schools/top-medical-school/research-rankings.

16. Davis GL, Dean RA, Reid CM, Gosman AA. The influence of academic pedigree on integrated plastic surgery resident training location. *J Surg Educ.* 2021;78:2138–2145. https://doi.org/10.1016/j.jsurg.2021.03.021.

17. Drolet BC, Brower JP, Lifchez SD, Janis JE, Liu PY. Away rotations and matching in integrated plastic surgery residency. *Plast Reconstr Surg.* 2016;137:1337–1343. https://doi.org/10.1097/PRS.0000000000002029.