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Scientific publication misrepresentation among orthopaedic residency applicants

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ABSTRACT

Background: The predictors of erroneous publication reporting among orthopaedic surgery residency applicants have not been established.

Methods: A retrospective analysis of the reported scholarly activity of candidates who applied to our orthopaedic surgery department for a first-year residency position in 2017 was conducted to determine the incidence of scientific publication misrepresentation and analyze its association with pre-residency criteria.

Results: Out of 510 candidates, 264 (51.8%) applicants included accepted, in-press, or published scholarly activity on their resumes. The incidence of misrepresentation was 20.5%, and did not differ statistically based on the candidates' academic performance (United States Medical Licensing Examination – USMLE – steps 1 and 2 scores), Alpha Omega Alpha (AOA) membership, immigration status, or or additional academic degrees ($p > 0.05$).

Conclusions: Misrepresentation is a persistent problem among residency training program applicants, and did not correlate with an applicant's academic performance, AOA membership, immigration status, or additional advanced academic degrees.

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Introduction

Demonstrating academic and research achievement is essential for applicants to medical and surgical residency training programs in highly competitive specialty fields such as orthopaedic surgery. For residency training programs, research represents one important aspect to distinguish potential candidates for residency positions from an increasingly growing pool of graduates. However, this process might, in some cases, be compromised by applicants who misreport their scholarly achievements. Misrepresentation is a well-documented problem among medical residency applicants in both highly competitive specialties as well as in less contestable fields.^{1–7}

Residency programs must typically screen a large number of applications for a limited number of positions, and many of the applications list scientific publications and other academic

achievements. Due to the competitive nature of this process, some applicants may embellish these scholarly accomplishments. This behavior, termed “academic misrepresentation,” has been reported in orthopaedic surgery residency and fellowship applications, with a prevalence ranging between 11% and 20.6%.^{8–10} The objectives of this study were to (1) establish the prevalence of erroneous citations among orthopaedic residency applicants to our training program; and (2) correlate this rate with individual applicant characteristics.

Materials and methods

This study, which was deemed exempt by our institutional review board, is a retrospective analysis of all applicants to our orthopaedic surgery training program for a first-year residency (PGY1) position in 2017.

The Electronic Residency Application Service (ERAS) was used to collect the applicants' demographic data, including gender, United States Medical Licensing Examination (USMLE) steps 1 and 2 scores, Alpha Omega Alpha (AOA) membership, and immigration status (International and American schools). Publication type (articles and abstracts) and number at the time of each candidate's application

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submission were retrieved using the same portal. Only published, accepted, or in-press papers in ERAS, were included in our analysis. All papers must have been listed in either “Peer-Reviewed Journal Article/Abstracts,” “Peer-Reviewed Journal Article/Abstracts (other than published),” or “Peer-Reviewed Online Publications” parts of the graduates’ applications. The veracity of these reported achievements were validated online using PubMed (<http://www.ncbi.nlm.nih.gov/pubmed/>) and Google Scholar (<https://scholar.google.com/>) for indexed and non-indexed manuscripts, respectively. All articles were also verified in their corresponding journals’ websites. Inaccuracies in listing an unpublished article as published were reflected by the “retrieval rate”, which was defined as the ratio of the numbers of verified to reported manuscripts. Authorship and/or journal listing errors were labeled as “misrepresentation”. These consisted of elevating or adding a candidate’s name in the authorship order, or listing a non-peer-reviewed publication in the peer-reviewed section of the submitted research material in ERAS. Spelling and grammatical inaccuracies, as well as errors involving abstract or manuscript pages, issues, or volumes were not regarded as erroneous citations. “Total reported works” encompassed the applicants’ reported abstracts, manuscripts, oral/poster presentations, as well as book chapters. Program-generated rankings of interviewed applicants were classified as either high (ranks 1 to 30) or low (ranks 30 to 59).

Descriptive analysis of the candidates’ demographic data was performed, including gender, USMLE steps 1 and 2 scores, AOA membership, and school of origin (American or International graduates). We determined the incidence of misreported publications (papers, abstracts, and total) in the entire population. The Student’s T-test was performed to compare the retrieval rates and USMLE steps scores. A Chi-square (χ^2) test was used to detect the relationship between the misreported publications and the applicants’ AOA membership, immigration status, and additional degrees earned. A Fisher’s exact test was used to estimate the relationship between our program-generated rankings and the candidates’ reported publications. The linear dependence between the applicant publication misrepresentation rate and USMLE scores was assessed by a Pearson correlation analysis. A p-value less than 0.05 was considered statistically significant. Data collected were processed by SPSS[®] version 24 (IBM Corp., Armonk, New York, USA).

Results

Demographic characteristics

In 2017, our institution received 510 applications for our 5 PGY1 orthopaedic surgery categorical training positions. Of those, 273 (53.5%) applicants reported research work on their resumes. Nine applicants were excluded from the analysis because their reported scholarly work consisted only of poster and/or conference presentations; the remaining 264 students constituted our study sample. The study group consisted of 53 (20.1%) females and 211 (79.9%) males. The mean USMLE steps 1 and 2 scores were 241 (95% confidence interval [CI] 214–268) and 249 (95% CI 221–277), respectively. Americans graduates (AGs, 241 applicants) had mean steps 1 and 2 scores of 241 (95% CI 215–268) and 249 (95% CI 222–277), while International graduates (IGs, 23 applicants) had mean scores of 241 (95% CI 210–271) and 245 (95% CI 216–278) (T-test, $p=0.89$ and $p=0.16$), respectively. The candidates’ demographic data are summarized in [Table 1](#).

Retrieval rate

Overall, the mean number of reported work was 15.3 (95% CI 0–49.5) per applicant, including 0.8 (95% CI 0–5.3) abstracts and

Table 1
Demographic characteristics of the study group.

Applicants	264 (100%)
Gender	
Male	211 (20.1%)
Female	53 (79.9%)
AOA membership	
Yes	93 (35.2%)
No	171 (64.8%)
Additional degree	
Yes	51 (19.3%)
No	213 (80.7%)
Immigration status	
AGs	241 (91.3%)
IGs	23 (8.7%)

6.0 (95% CI 0–20.5) articles in the entire applicant pool. Of those, we were successfully able to verify 0.2 (95% CI 0–1.3) abstracts and 3.9 (95% CI 0–14.9) manuscripts per applicant on average ([Table 2](#)). Of the 1288 reported citations (97 abstracts and 1191 articles), 1071 (54 abstracts and 1017 manuscripts) were retrieved. The general retrieval rate was 83.2% (55.7% for the reported abstracts and 85.4% for the articles).

Erroneous reporting

Fifty-four (20.5%) out of 264 graduates had at least 1 erroneous citation. This included either authorship or journal listing errors. Elevating one’s own rank in the authorship order was more frequently encountered compared to journal listing errors (i.e. a reported peer-reviewed published manuscript that was actually published in a non-peer-reviewed journal). Forty (15.2%) and 8 (3%) applicants had authorship and journal listing errors, respectively, while 6 (2.3%) had both. Of the 40 candidates with authorship order inaccuracies, 29 (72.5%) elevated their rank in the authors’ list of the final publication, while 11 (27.5%) erroneously added their name in the final version of the published manuscript or abstract. In the entire population, the mean number of incorrect author listing was 0.2 (95% CI 0–1.3), compared to 0.1 (95% CI 0–0.6) incorrect journal reporting per applicant.

Predictors of misrepresentation

We sought to identify factors that might be associated with a higher risk of misrepresentation in our entire population ([Table 3](#)). Twenty-one (22.6%) out of 93 graduates with erroneous citations were members of the AOA, while 33 (19.3%) out of 171 non-AOA members had misreported publications (Chi-square, $p=0.58$). Forty-eight (19.9%) AGs out of 241 misrepresented their publications, compared to 6 (26.1%) out of 23 IGs (Chi-square, $p=0.48$). Similarly, having an additional degree was not associated with an increased likelihood of misrepresentation, since 27.5% (14 out of 51) and 18.8% (40 out of 213) applicants with or without an additional degree were respectively misrepresented (Chi-square, $p=0.17$). Despite the linear dependence analysis showing that applicants with high USMLE scores had lower numbers of erroneous citations, the relationship was weak (Pearson’s correlation coefficient, $r=-0.179$ and $r=-0.183$ for steps 1 and 2, respectively).

Eighty (15.7%) of 510 candidates applying to our orthopaedic surgery residency training program were invited to interview, but 64 (12.5%) attended and 59 were included on the program’s rank list. Twenty-eight (47.5%) of those 59 candidates had publications reported on their submitted materials in ERAS and were highly ranked (positions 1 to 30) by our program, compared to 6 (10.2%) applicants with no publications being less favorably ranked (Fisher’s exact test, $p<0.01$).

Table 2
Mean total and specific numbers of reported work in the population subgroups.

	AOA	No AOA	AGs	IGs	Additional degree(s)	No additional degree(s)
Gender						
Male	74 (20.4%)	137 (80.1%)	194 (80.5%)	17 (73.9%)	40 (78.4%)	171 (80.3%)
Female	19 (79.6%)	34 (19.9%)	47 (19.5%)	6 (26.1%)	11 (21.6%)	42 (19.7%)
Total reported works	13.5 (95% CI 0–38.8)	16.2 (95% CI 0–54.4)	14.3 (95% CI 0–47)	25 (95% CI 0–69.1)	16.2 (95% CI 0–44.9)	14.7 (95% CI 0–49.7)
Reported abstracts	0.7 (95% CI 0–4.5)	0.9 (95% CI 0–5.8)	0.8 (95% CI 0–5.2)	1.2 (95% CI 0–6.8)	1.6 (95% CI 0–9.4)	0.6 (95% CI 0–3.7)
Reported articles	5.2 (95% CI 0–16.2)	6.4 (95% CI 0–22.5)	5.6 (95% CI 0–20)	9.6 (95% CI 0–24.6)	5.7 (95% CI 0–14.9)	5.9 (95% CI 0–21.3)
Total retrieval rate	80.7% (95% CI 64.9–96.5)	84.3% (95% CI 70.1–98.5)	83.7% (95% CI 70.8–97.2)	80.1% (95% CI 62.5–97.7)	84.3% (95% CI 32.1–100)	83.4% (95% CI 31.2–100)
Abstracts retrieval rate	48.5% (95% CI 31.8–65.2)	59.4% (95% CI 18.5–100)	58.3% (95% CI 23.1–93.5)	38.5% (95% CI 0–98.5)	42.7% (95% CI 0–100)	41.2% (95% CI 0–100)
Articles retrieval rate	83.5% (95% CI 67–100)	86.3% (95% CI 71.7–100)	85.8% (95% CI 72.7–98.9)	83.5% (95% CI 65.5–100)	83.7% (95% CI 68.5–100)	85.5% (95% CI 72.7–98.5)

Discussion

Orthopaedic surgery is one of the most competitive surgical residencies in the United States.^{11–13} The relatively limited number of residency positions currently available makes it very challenging for graduates to secure a position. This process is further complicated by the lack of standardized selection criteria upon which training programs might rely to grant interviews to potential candidates.¹⁴ At some institutions, a research interest, often reflected by the applicants' publications, is emphasized in the selection and ranking process. Therefore, academic and research reporting can be a crucial portion of a candidate's application. However, the highly competitive nature of the application process might tempt some applicants to misrepresent the actual extent or nature of their academic accomplishments.

Academic misrepresentation is a phenomenon that has been encountered in residency and fellowship applications in many medical and surgical specialties.^{1–7} More specifically, in orthopaedic surgery, the two prior reports detected misrepresentation rates of 18% and 20.6% among candidates applying to residency.^{8,9} Another study showed a rate of 11% among residents seeking an orthopaedic surgery fellowship position.¹⁰ Our analysis revealed a retrieval rate of 83.2%, with more than 15% of the reported work unable to be directly verified. This retrieval rate was higher for reported manuscripts (85.4%) than abstracts (55.7%), and is likely due to the fact that abstracts, presentations, and posters presented at meetings or listed in conference proceedings are not consistently published. Moreover, despite using different criteria to define a misrepresented publication, our study found a misrepresentation rate of 20.5%, similar to the most recent rate reported.⁹

Our findings suggest that erroneous citation is not associated with nor predicted by the applicants' AOA membership, additional degrees earned, immigration status, or USMLE scores. This might be explained by a tendency for applicants to embellish their applications, regardless of the origin of their medical school, honor medical society memberships, or academic performance. However, in the context in which candidates with published work are being ranked higher than the ones without, misrepresentation is clearly an important metric for admissions committee to validate before granting interviews to potential applicants.

Our findings may be explained by several hypotheses. Misrepresentation might simply be an unconscious mistake or a behavior that should be efficiently screened and reported. Many residency training programs highly value research, which might have prompted some to list themselves as an author on as many articles as possible. For some applicants, the prospects of matching seem to outweigh the ethical concerns associated with misrepresenting their academic achievements.

Our study has some inherent weaknesses. First, limiting the study to only applicants to our program makes it difficult to generalize our findings to other orthopaedic surgery training programs. Our study was also a single time-point assessment, which makes comparison with historical data difficult and imprecise. Moreover, the retrospective nature of the analysis and the use of different criteria to define misrepresentation may have underestimated the rate of erroneous reporting. Some candidates might have work accepted for publication at the time of their application submission that yet to be published, sent back for additional revisions, or rejected afterwards. However, to account for journals delays in publication, we validated all the applicants' reported publications in database engines (Pubmed and Google Scholar) and the reported journals' websites, an approach that was not used by others.^{8,9} Because the applicant rank lists constitute privileged information, we were unable to assess the correlation between misrepresentation and applicant-generated ranking lists. We decided to distinguish abstracts from manuscripts because we believe that these entities are different in their impact, and therefore the amount of work needed to be generated as well as their retrieval validation. We did not include poster and conference presentations in our analysis, since this work is very hard to be accurately verified. This might be reflected by applicants who present a single study at several different conferences, which might lead to the deceptive impression that training programs are receiving applications with higher numbers of original, rather than redundant, reported work.

In conclusion, our study suggests that scholarly activity misrepresentation remains a major issue among orthopaedic surgery residency applicants, regardless of their USMLE performance, honor medical society memberships, and school of origin. Training programs should be cognizant of the extent of misrepresentation

Table 3
Erroneous rates based on the applicants' gender, AOA membership, and immigration status.

	Male (n = 214)	Female (n = 50)	AOA membership (n = 93)	Not AOA (n = 171)	AGs (n = 241)	IGs (n = 23)	Additional degree (n = 51)	No additional degree (n = 213)	Entire population (n = 264)
Erroneous rate	44 (20.6%)	10 (20%)	21 (22.6%)	33 (19.3%)	48 (19.9%)	6 (26.1%)	14 (27.5%)	40 (18.8%)	54 (20.5%)
p-value	0.93		0.58		0.48		0.17		

among applicant-reported research publications, and establish validation policies to determine the accuracy of these reported scholarly activity efforts.

Conflicts of interest

None of the authors have any financial or personal relationships with other people or organizations that might pose a conflict of interest in connection with the submitted article.

Disclaimers

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References

- Beswick DM, Man LX, Johnston BA, et al. Publication misrepresentation among otolaryngology residency applicants. *Otolaryngology–head and neck surgery. Offic J Am Acad OtolaryngolHead Neck Surg.* 2010 Dec;143(6):815–819. PubMed PMID: 21109083.
- Kistka HM, Nayeri A, Wang L, et al. Publication misrepresentation among neurosurgery residency applicants: an increasing problem. *J Neurosurg.* 2016 Jan;124(1):193–198. PubMed PMID: 26207605.
- Phillips JP, Sugg KB, Murphy MA, Kasten SJ. Misrepresentation of scholarly works by integrated plastic surgery applicants. *Plast Reconstr Surg.* 2012 Sep;130(3):731–735. PubMed PMID: 22929257.
- Wiggins MN. Misrepresentation by ophthalmology residency applicants. *Arch Ophthalmol.* 2010 Jul;128(7):906–910. PubMed PMID: 20625054.
- Caplan JP, Borus JF, Chang G, Greenberg WE. Poor intentions or poor attention: misrepresentation by applicants to psychiatry residency. *Acad Psychiatr : J Am Assoc Directors Psychiatr Resid Training Assoc Academic Psychiatry.* 2008 May-Jun;32(3):225–229. PubMed PMID: 18467480.
- Gurudevan SV, Mower WR. Misrepresentation of research publications among emergency medicine residency applicants. *Ann Emerg Med.* 1996 Mar;27(3):327–330. PubMed PMID: 8599492.
- Neuman SA, Long TR, Rose SH. Publication misrepresentation among anesthesiology residency applicants. *Anesth Analg.* 2011 Mar;112(3):674–677. PubMed PMID: 21156985.
- Dale JA, Schmitt CM, Crosby LA. Misrepresentation of research criteria by orthopaedic residency applicants. *J Bone Joint Surg Am Vol.* 1999 Dec;81(12):1679–1681. PubMed PMID: 10608378.
- Konstantakos EK, Laughlin RT, Markert RJ, Crosby LA. Follow-up on misrepresentation of research activity by orthopaedic residency applicants: has anything changed? *J Bone Joint Surg Am Vol.* 2007 Sep;89(9):2084–2088. PubMed PMID: 17768209.
- Patel MV, Pradhan BB, Meals RA. Misrepresentation of research publications among orthopedic surgery fellowship applicants: a comparison with documented misrepresentations in other fields. *Spine.* 2003 Apr 1;28(7):632–636. PubMed PMID: 15164751.
- Andriole DA, Schechtman KB, Ryan K, et al. How competitive is my surgical specialty? *Am J Surg.* 2002 Jul;184(1):1–5. PubMed PMID: 12135709. Epub 2002/07/24.
- Andriole DA, Whelan AJ, Schechtman KB. Recent trends in match process outcomes for U.S. senior medical students. *Academic medicine. J Assoc Am Med Colleges.* 2003 Oct;78(10 Suppl):S6–S9. PubMed PMID: 14557081. Epub 2003/10/15.
- Rinard JR, Mahabir RC. Successfully matching into surgical specialties: an analysis of national resident matching program data. *J Grad Med Educ.* 2010 Sep;2(3):316–321. PubMed PMID: 21976075. Pubmed Central PMCID: PMC2951766. Epub 2011/10/07.
- Raman T, Alrabaa RG, Sood A, et al. Does residency selection criteria predict performance in orthopaedic surgery residency? *Clin Orthop Relat Res.* 2016 Apr;474(4):908–914. PubMed PMID: 25940336. Pubmed Central PMCID: 4773357.