Assessment of Orthopedic Educational Research in 2015 Publications

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BACKGROUND: Due to orthopedic surgery's unique educational model, recent changes within graduate medical education have the potential to impact the methods and outcomes of specialty training significantly. Using *Mind the Gap: Representation of Medical Education in Cardiology-Related Articles and Journals* (Allred et al., 2016) as a framework, this study investigates educational research within the field of orthopedics.

OBJECTIVE: Two main objectives were evaluated: (1) quantitative analysis of the amount and type of orthopedic education-related research in orthopedic, general surgery, and medical education journals and (2) estimate the priority of orthopedic journals to publish education-focused articles.

METHODS: Using a composite citation-based 5-metric scoring system, a complete list of journals pertaining to orthopedics, nonorthopedic specific surgery journals, and general medical education journals was ranked. All publications during 2015 for the selected cohort of journals were then analyzed for orthopedic education-related publications. Aim and scope of the top 15 selected orthopedic journals (along with the mission statements of their associated societies) were evaluated with a word cloud generator to determine priority on education.

RESULTS: Review of 7112 articles from the top 15 selected orthopedic journals yielded 37 publications with an educational focus. Evaluation of 15 general surgery or medical education journals, containing 4661 publications, generated an additional 28 positive articles. In total, 51 unique orthopedic education-related publications (0.43% of total evaluated articles) were identified from the 11,773 articles published in the selected 30 journals for 2015.

CONCLUSION: The lack of emphasis on orthopedic educational research output is multifactorial, needing further evaluation to determine specific causes and methods of improvement. This article adequately sheds light on the need to increase support of educational research programs within the field of orthopedics. (J Surg Ed 76:578–584. © 2018 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: orthopedics [H02.403.810.494], orthopedic surgeons [M01.526.485.810.910.875], education, medical, graduate [I02.358.337.350], education, medical, graduate [I02.358.399.350]

COMPETENCIES: Patient Care, Medical Knowledge, Practice-Based Learning and Improvement

INTRODUCTION

Recent changes to the educational teaching structure of medicine, specifically in graduate medical education, have had varying effects on physician instruction. Changes to resident duty hours have been especially controversial within the field of orthopedic surgery. One recent study found "some support for improved resident quality of life, improved resident sleep and less fatigue, a perceived negative impact on surgical operative and technical skill, and conflicting evidence on the topic of resident education, patient outcomes, and variable attitudes toward the work-hour changes"[1] for orthopedic surgeries trainees. The very nature of orthopedic training in the operating room takes extensive amounts of time, making this specialty's educational methods potentially more vulnerable to change.[2] Ultimately, these alterations in policy and their relatively unknown ramifications will affect physician training to some degree. Solutions to potential problems and increasing training effectiveness and efficiency have become paramount in importance. As the field of medical education

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expands, increased focus should be placed on evidence-based medical education, and not on the traditional opinion driven models of the past.[3] Using *Mind the Gap: Representation of Medical Education in Cardiology-Related Articles and Journals* (Allred, Berlacher, Aggarwal, Auseon)[4] as an initial framework for this article, we elected to investigate multiple aspects regarding education research within the field of orthopedics. With this goal, 2 main objectives were evaluated: (1) quantitative analysis of the amount and type of orthopedic education-related research in orthopedic, general surgery, and medical education journals and (2) estimate the priority of orthopedic journals to publish education-focused articles.

METHODS

Compilation of Journal Lists

Using Thomson Reuters' InCites Journal Citation Reports,[5] a list of all journals in the "orthopedics," "surgery," and "education, scientific disciplines" categories was obtained. Five different citation-based metrics (Impact Factor, Immediacy Index, Source-Normalized Impact Per Paper, SCImago Journal Rank, and Google Scholar 5-year h-index)[5-8] for 2015 were added for each journal if available. The results of the mean composite ranking are shown in Table 1 for the top 15 orthopedic journals (OJs). This technique was used due to the wide variability between different ranking systems and to objectively assess a journal's impact in the academic community.[9] Figure 1 depicts the mean composite score and 5-metric range of each of the top 15 OJs. Nonorthopedic specific surgery journals (GSJs) and general medical education journals (MEJs) were selected from their overall respective lists and analyzed by the same 5-metric method. The mean composite ranking results for GSJs and MEJs are displayed in Table 2. There were a number of OJs with representation on both OJ and GSJ lists that were excluded in the GSJ analysis.

TABLE 1. Top 15 OJs Ranked by 5-Metric Criteria

Ranking	Journal
1	Am J Sports Med
2	Arthroscopy
3	J Bone Joint Surg Am
4	Clin Orthop Relat Res
5	Bone Joint J
6	Acta Orthop
7	Spine J
8	J Am Acad Orthop Surg
9	J Orthop Res
10	Knee Surg Sports Traumatol Arthrosc
11	J Shoulder Elbow Surg
12	Int Orthop
13	Bone Joint Res
14	J Spine
15	J Arthroplasty

Publication and Author Search

After list finalization, the title and abstracts of the top 15 OJs including regular and supplemental issues for 2015 were screened on PubMed, a free online biomedical literature search engine,[10] for specific pertinent keywords: resident, curriculum, student, education, development, teaching methods, evaluation, learning, training, fellowship, technology.[11] Search results were then manually screened to determine articles pertinent to orthopedic education. Letters to the editor, book reviews, and creative writing were excluded from results. GSJs and MEJs were screened using similar key terms (orthopaedics, orthopaedic, orthopedics, orthopedic) and manually sorted to determine appropriate inclusion criteria. All positive articles were documented along with their original list they populated under. The total list of articles meeting inclusion criteria was manually compared to remove duplicate submissions.

Review of Orthopedic Journal Mission Statements

To establish the priority of OJs in education publication, the aim and scope of the top 15 selected OJs (along with the mission statements of their associated societies) were obtained verbatim. After compilation, they were entered into a free online word cloud creator[12] to generate a visual representation of the frequency of the top 30 keywords. Nonrelevant terms such as association, articles, disseminating, highest, important, issue and/or journal, original, and publication and/or publish were omitted from analysis. Figure 2 displays these results with direct correlation of font size to term frequency (larger indicating more references). The total number of keyword citations is represented by the number in parentheses to the right of each specific term. Although with significant limitations, this form of textual analysis that works at " 'quantitising' qualitative data," effectively and rapidly condenses large amounts of data to a manageable visualized format.[13]

RESULTS

Medical Education Publications in Orthopedic Journals

Of the initial 74 OJs listed from the Journal Citation Reports list, 17 journals were omitted initially due to

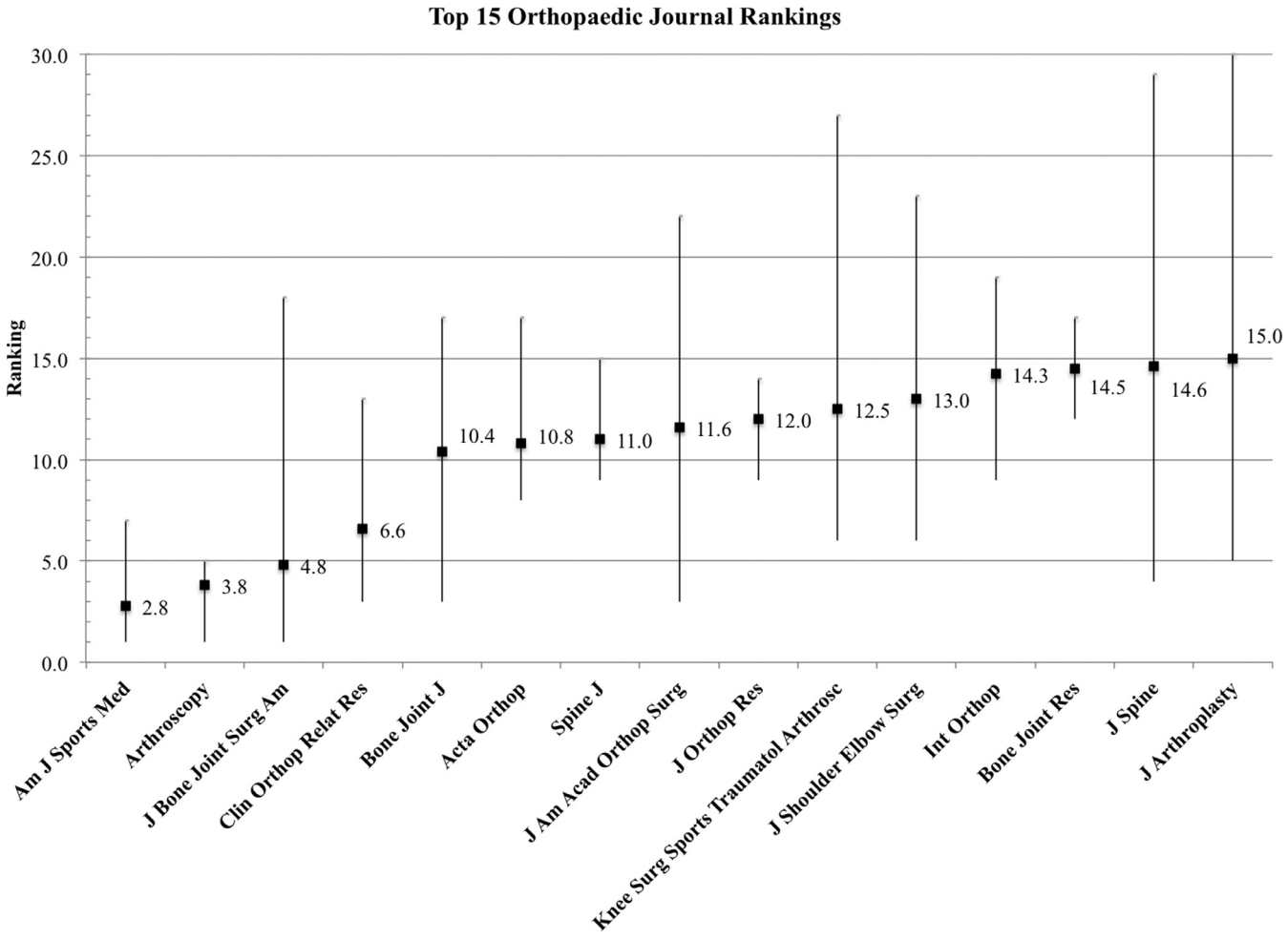

FIGURE 1. Note: Composite rankings is represented by the number adjacent each respective journals column. The error bars represent the ranking range of each corresponding journal.

content not related to orthopedic surgery. The rest were analyzed with the 5-metric method described in the "Methods" section and reranked. All of the remaining 57 journals were initially included in the publication search, but after manual sorting of key term results, it became evident that a large majority of the orthopedic education publications appeared in the top stratum of journals. For the 57 initial OJs, manual sort yielded 48 orthopedic education-related articles. Total combined unique orthopedic education articles for the top 30, 15, and 10 OJs were 46, 37, and 36, respectively. For this reason, the top 15 OJs were set as the analysis cutoff marker. In the top 15 subset, a total of 7112 articles were published in 2015. Keyword screen returned 337 positive search results, of which, 37 were related to orthopedic education (0.52%). This number is only slighted improved (0.77%) if only the top 10 OJs are selected. Twenty articles (53%) focused on surgical skill acquisition, teaching, and evaluation. Other article topics ranged from work-hours restriction evaluation to impact of fellowships and subspecialization training. Arthroscopy was the most popular subject (14 articles, 37%).

Orthopedic Publications in Surgical and Medical Education Journals

To further examine the extent of orthopedic education articles published, 6 GSJs and 9 MEJs were searched (Table 2). Of the total 2725 articles published in the 6 GSJs for 2015, only 3 papers focused on orthopedic education. One of those 3 publications was unique to the GSJ pool, the other 2 having duplicate publications in another OJ. A total of 1936 articles were published in 2015 for the 9 MEJs examined. Keyword screening and subsequent manual classification located 25 publications with an emphasis on orthopedic education. Cross-referencing with positive articles from the OJs and GSJs list, 13 were found to be unique with the remaining

TABLE 2. Top GSJs and MEJs Ranked by 5-Metric Criteria

Ranking	Journal	Subject
1	Ann Surg	GSJ
2	Br J Surg	GSJ
3	JAMA Surg	GSJ
4	J Am Coll Surg	GSJ
5	Surgery	GSJ
5	J Trauma Acute Care Surg	GSJ
1	Acad Med	MEJ
2	Med Educ	MEJ
3	Anat Sci Educ	MEJ
4	Med Teach	MEJ
5	Med Educ	MEJ
6	J Surg Educ	MEJ
7	J Contin Educ Health Prof	MEJ
8	BMC Med Educ	MEJ
9	Teach Learn Med	MEJ

13 flagged as duplicate publications. Subjectively, examiners found that the breadth of subject matter was wider in the MEJ articles. Topics included: surgical skill teaching and evaluation, fracture course impact, Orthopedics In-Training Exam evaluation, musculoskeletal ultrasound curriculum, and resident radiation safety project. Of the combined 30 journals searched (OJs, MEJs, and GSJs), there were 11,773 articles published in 2015. Our search located 51 unique articles (0.43%) focused on orthopedic education within this cohort.

Review of Orthopedic Journal Mission Statements

Aim and scope of the top 15 selected OJs along with the mission statements of associated societies were obtained verbatim, compiled, and processed using a free online word cloud generator.[12] The top 30 keywords (1068 possible) by frequency is displayed in Figure 2. The top 5 terms were: orthopedic (20), surgery (19), research (16), clinical (13), and education (10). The word cloud represents the keyword frequency and acts as a visual cue to the relevant topics.

DISCUSSION

In 2016, the American Academy of Orthopedic Surgeons conducted their biennial study, Orthopedic Practice in the United States, reporting 29,613 orthopedic surgeons in practice.[14] This number can be distilled into active (92%) and part-time physicians (8%). When comparing this study to the reported number of active physicians by specialty documented by the Association of American Medical Colleges, there is a significant underestimation of total practicing orthopedic surgeons by the

FIGURE 2. Key Terms Cited in Orthopedic Surgery Journals and Associated Societies Mission Statements as Reflection of Publishing Priorities. Note: Top 30 words are demonstrated above with font size determined by repetition frequency. Total number of keyword citations is represented by the number in parentheses right of each specific term. (Image creation credit: tagcrowd.com.)

Association of American Medical Colleges (8099 less orthopedic surgeons).[15] Despite this discrepancy that likely applies across the board to other specialties, an important point can be gleaned from this information. Regardless of the true active physician population for each specialty, orthopedic surgery is firmly entrenched as a top 10 specialty in terms of total number of active physicians. Further stratifying the data, active orthopedic surgeons comprise the third most populous surgical specialty behind general surgery and obstetrics-gynecology.

The American Academy of Orthopedic Surgeons' Orthopedic Practice in the United States measures many different demographic variables of practicing orthopedic surgeons such as age, sex, practice setting, group size, and work hours. Particularly interesting for this assessment is the percentage of orthopedic surgeons that identify their practice setting as "Academic Practice" with their compensation stemming from a private practice or academic institution. In total, this subset of academians comprises 19% of all orthopedic surgeons (5626). Obstetrics-gynecology, in contrast, has 35,586 practicing physicians today with only 4208 providers in an academic practice as of 2012.[16] Overall, this equates to an average 34.7 orthopedic faculty per residency program in 2015 to 2016 and a 1.53 faculty to resident ratio, both considerably higher than that of other surgical specialties.[17]

Comparing orthopedic surgery to other specialties, the amount of yearly research output (11,717 total, 13th in total yearly journal articles published)[5] is roughly on par with the rank of total active orthopedic surgeons in the field. However with a significant portion of orthopedic surgeons practicing in an academic environment focused on resident and fellow education, one would expect a greater amount of research focused on educational improvement. Further highlighting this lack of substantial orthopedic education research, none of the top 100 most cited orthopedic articles (as of 2010) emphasized educational subjects.[18]

Review of the 15 selected OJ's mission statements confirmed our initial theory that OJs are focused on education and research (both top 5 mentioned terms), but with a postgraduate subscribership in mind. This is understandable given the majority of orthopedic surgeons have completed their training and are not in an academic teaching setting. As a consequence of journals' needs to cater content to their readers to ensure continued subscriptions, the incentive to highlight orthopedic educational research is minimal.

As with any complex problem, this lack of published research is most likely due to multiple causes. Although resident education is a critical component of academic orthopedics, both faculty and residents have a broad variety of clinical and basic science research interests to pursue of which education is a small subset. Additionally, if there is interest to pursue educational research, various barriers potentially exist challenging project development and completion such as lack of resources, adequate mentor support, and general unfamiliarity with the field. Although this paper does not propose ways to increase the amount of orthopedic educational research output, we hope it serves as an impetus for further investigation and positive change.

Though not a primary focus in our evaluation of orthopedic educational research, this search allows for an in-depth look at what topics are being published in the educational realm of orthopedics. This cross section of researchers' work in 2015 is interesting to analyze not to ascertain where progress is being focused, but also where deficiencies may lie. Of the 51 unique articles found by our analysis between the selected OJs, MEJs, and GSJs, a large percentage (29%) focused on improvement, evaluation, and teaching arthroscopic surgery. We found this unsurprising though because the sole operator nature of the surgery, time-constraints to teaching due to tourniquet time and heavy case volume, and nonintuitive skill acquisition requiring significant practice to gain competency. Five articles focused on patient safety in relation to resident training. These articles assessed how various facets of resident training like work-hours restrictions or sleep deprivation have effected patient safety and quality of care. Other topics within the relevant article subset included surgical skill teaching and evaluation, fracture course impact, Orthopedics In-Training Exam evaluation, musculoskeletal ultrasound curriculum, and resident radiation safety projects.

Our assessment of potential education-related publications has several limitations that should be addressed. First, the OJ selection process is potentially flawed. After analysis by the 5-metric system, the top 30 journals were chosen as the analysis cut-off point. This was done to exhibit a more realistic view of publication percentage and reduce the large skew of unique orthopedic education articles compared to total publications that occurred with inclusion of all 57 OJs. Though a seemingly negligible effect on the percentage of orthopedic education-related articles in relation to total publications (0.35% for all 57 OJs vs 0.52% top 30 OJs), it does alter the reported percentage by +148%, adding a layer of uncertainty to the review. Due to the large amount of information needing to be processed, PubMed was used to screen large pools of papers for key title words. This filter induces potential inaccuracies in the count if orthopedic education article titles did not contain those key terms. Manual sorting of articles also induced a degree of uncertainty for articles that had questionable graduate medical

education focus. We estimate that the variable inclusion or exclusion of articles dependent on reviewer judgment could have swayed numbers by up to 20 articles. Other searches may obtain larger number of potential articles, but we believe the manual selection process was accurate in elimination of duplicate counts from articles published in multiple journals and those that had correct keywords, but little relation to orthopedic education. Additionally, this study did not analyze the number of articles submitted or rejected to OJs. With only retrospective published article counts, we are unable to ascertain the actual amount of orthopedic education-related research studied in 2015. While other search and analysis methodologies may yield differing numbers of relevant articles, we believe that our search is relatively accurate given the scope of articles to evaluate and a good representation of the dearth of orthopedic education-related publications that occur yearly. Total article counts between our methodology and other computations would likely vary but with minimal impact on overall results.

We believe that this is the first study to assess the quantitative amount of orthopedic education across a complete year. Allred et al. reviewed the cardiology literature over the course of a year and showed similar findings that only few articles specifically focus on education and are written by a narrow group of individuals. These findings suggest that graduate medical education journals have a collective tendency to rarely publish articles specifically aimed at educational aspects.

CONCLUSIONS

After a review of all 2015 articles published in 30 selected orthopedic, general surgery, and medical education journals, 51 unique orthopedic education-related publications were identified (0.43% of total evaluated articles). The lack of emphasis on orthopedic educational research output is multifactorial, needing further evaluation to determine specific causes and methods of improvement. This article adequately sheds light on the need to increase support of educational research programs within the field of orthopedics. Possible catalysts for encouragement in orthopedic education research include increased grant funding and encouragement by both journals and national orthopedic societies in expanding educational research.

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