Open Access and Online Journals in Orthopaedics: What Does the Future Hold?

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» Open access publishing is a rising trend in the orthopaedic literature and allows for free, public, and international availability of research findings.

» In contrast to traditional subscription journals, open access journals shift the financial burden of publishing from university libraries to authors and their individual research funds and grants.

» The benefits of open access include rapid knowledge dissemination without cost to consumers of the scientific literature, which may decrease research duplication and increase the rate of scientific progress, especially in the developing world.

» The potential risks of open access include the creation of journals with low oversight and minimal impact that may compromise the quality of the scientific literature.

» Researchers and surgeons alike are responsible for maintaining the quality of the orthopaedic literature by participating in the peer-review process and avoiding the temptation to publish quickly.

Illustrative Scenario

An orthopaedic surgeon has just completed a clinical outcomes research project in his area of expertise and wishes to publish a report in a widely read journal so that he can share his findings with the orthopaedic community. After the manuscript was rejected by two widely read subscription-based orthopaedic journals, the author submits the work to a so-called "peer-reviewed open access" orthopaedic journal that he finds online. Within two months, he receives a congratulatory acceptance letter stating that the manuscript has been accepted without revision and will be published both online and in print with open access. He is required to pay a $1400 processing fee to publish the work. He is hesitant to proceed because of his unfamiliarity with the title of the journal that he has selected, open access publishing, and the request for a processing fee.

Introduction to Open Access

Although the first open access journals did not appear in the biomedical literature until the 1990s, such journals have assumed an increasingly prominent role in the academic publishing arena over the past two decades. Today, calls for open access

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continue to grow on the basis of the central concept that "peer-reviewed research articles, donated for publication by authors with no expectation of compensation, should be available online, free, and with the smallest possible number of usage restrictions."[1] The aim of the present review is to provide a brief history of open access journals, to review the orthopaedic journals that currently participate in open access, to address the concept of predatory publishers, and to discuss the future implications of adopting this new publication paradigm.

Open access may be defined as the "unrestricted online access to articles published in scholarly journals."[2] Within the framework of open access, there are two models: *gold open access*, in which publishers make articles freely available to all, and *green open access*, in which authors upload their manuscripts to the web for distribution, often via manuscript-archiving services[3]. While the former is more common in medicine (including orthopaedics) and biology, the latter is more prevalent among disciplines such as mathematics, earth sciences, social sciences, engineering, and physics[4]. Other important terms include *direct open access* (which refers to journals that are fully available without limitations), *delayed open access* (which denotes free access after a defined period of time), and *hybrid open access* (whereby authors may choose to pay for open access or proceed with traditional subscription-based publication)[4]. Most open access journals utilize a Creative Commons license, which permits the public to freely share, copy, and distribute the work as long as the work is appropriately attributed to the authors, is not altered, and is not used for commercial purposes[5]. Given that open access journals do not generate revenue via subscription fees, they often require authors to pay article-processing charges to cover the costs of publication. A newer designation, *platinum open access*, recently has been coined to identify journals that do not charge article-processing fees for publication[6].

The transition toward open access has been directed by several forces, including technology, finances, ethics, and professional incentives. One of the most important factors in this regard has been the transition to electronic publishing—driven by the growth of the Internet over the past twenty years—which has promoted open access by allowing the low-cost digital distribution of scientific articles[7]. At the same time, traditional subscription prices have continued to rise, often faster than the rate of inflation[8]. While specific prices often are hidden by nondisclosure agreements, estimates have suggested that university libraries sometimes can be required to pay up to $20,000 for a single journal title[9,10]. These high costs have forced many libraries to cancel journal subscriptions, thereby confining comprehensive journal collections to large, affluent institutions[11,12]. This "crisis of accessibility" has further engendered support for open access as it promises to keep scientific information available to researchers. In fact, proponents of open access argue that making scientific data instantaneously available to all will benefit not only researchers (by reducing the duplication of work) but also the general public (who will reap the benefits of more rapid scientific progress)[13,14].

Open access journalism also has been supported by academicians, whose promotions and professional advancement are often determined, at least in part, by publications. The availability of a wide variety of journals in which to publish can support the ever-increasing pressures to publish novel research.

Proponents of open access also have criticized the traditional model of subscription journals, arguing that it allows scientific journals to profit from the time, effort, and funds provided by others. They note that the most demanding aspect of the publication process—peer review—is largely performed by academics who lend their time and energy on a volunteer basis. Research projects may be funded by government agencies, but it is the (privately owned) scientific journals that reap the profits[8]. The revenue generated by a single article has been estimated to be approximately $5000, which allowed the scientific publishing industry to generate revenues totaling $9.4 billion in 2011[8]. As a result, the annual profit margins of academic publishers have been estimated to be around 20% to 50%[8,15]. Advocates of open access have suggested that there is an "obligation of reciprocity," whereby research that has been funded with tax dollars should be freely available to the lay public who has already paid for it and to the researchers who have created it[12,13]. Similarly, government agencies, charitable foundations, and private funders all share the desire to ensure that their research is widely available to the public[1]. It is accepted that peer review has a cost, and it is expected that open access journals will charge article-processing fees to cover publishing expenses in order to allow for free and immediate access to the literature. However, the profit margins of open access journals are often considerably smaller, and overall production costs are typically lower. For example, the most widely known open access journal, *PLoS One*, charges $1350 per article, a figure that is one-third of the cost of publishing an article in the *Proceedings of the National Academy of Sciences* and 1/25th of the estimated cost of publishing an article in *Nature*[8,10].

Pros and Cons of Open Access: What Do the Data Show?

As open access has become more widespread, it has garnered both support and opposition. In the field of orthopaedics, the availability of open access journals has been touted as providing several potential advantages to the worldwide orthopaedic community. For example, advocates contend that open access will result in an increased rate of article citation and, presumably, greater dissemination of knowledge[13,14,16,17]. Although we are not aware of any studies that have specifically examined the effect of open access on the rates of article citation in orthopaedics, a few studies in

TABLE I Orthopaedic Open Access Journals in 2013

Journal Name	Article-Processing Charges	First year of publication	2012 Impact Factor*
Acta Orthopaedica	$0	1930	2.736
Acta Orthopaedica et Traumatologica Turcica	$0	1963	0.597
Acta Ortopédica Brasileira	$0	2000	
Advances in Orthopedics	$800	2011	
Archives of Orthopaedic and Trauma Surgery	$3000	1903	1.358
Arthritis Research & Therapy	$1500	2003	4.302
Asian Journal of Sports Medicine	$0	2010	
BMC Musculoskeletal Disorders	$2000	2000	1.875
BMC Sports Science, Medicine and Rehabilitation	$2000	2013	
Bone & Joint Research	$750	2012	
Case Reports in Orthopedics	$300	2011	
Foot and Ankle Online Journal	$0	2008	
Indian Journal of Orthopaedics	$0	2007	0.737
International Journal of Shoulder Surgery	$0	2007	
The Internet Journal of Hand Surgery	$225	2007	
The Internet Journal of Minimally Invasive Spinal Technology	$225	2007	
The Internet Journal of Orthopedic Surgery	$225	2001	
The Internet Journal of Spine Surgery	$225	2005	
The Iowa Orthopaedic Journal	$0	1981	
ISRN Orthopedics	$0	2011	
Journal of Foot and Ankle Research	$1730	2008	1.466
Journal of Orthopaedic Case Reports	$150	2011	
The Journal of Orthopaedic Surgery	$0	2005	
Journal of Orthopaedic Surgery and Research	$2285	2006	1.013
Journal of Orthopaedics	$0	2004	
Journal of Orthopaedics and Traumatology	$0	2000	
Journal of Sports Science and Medicine	$475	2000	0.953
Kerala Journal of Orthopaedics	$0	2011	
Open Access Journal of Sports Medicine	$1865	2010	
The Open Bone Journal	$600-900	2009	
Open Journal of Orthopedics	$500	2011	
The Open Orthopaedics Journal	$600-900	2007	
The Open Spine Journal	$600-900	2009	
The Open Sports Medicine Journal	$600-900	2007	
Orthopaedic Journal of Sports Medicine	$1000	2013	
Orthopedic Research and Reviews	$1695	2009	
Orthopedic Reviews	$550	2009	
SA Orthopaedic Journal	$0	2010	
Scoliosis	$1730	2006	
Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology (SMARTT)	$2000	2009	
Strategies in Trauma and Limb Reconstruction	$0	2006	
World Journal of Orthopedics	$600	2010	

*If available.

other fields have been performed to define this relationship[17-20]. In controlled experiments performed in the fields of physiology, general sciences, and social sciences, for example, investigators found that free access increased the frequency of article downloads and citations within the first year after publication but that these rates normalized after three years[16,21,22]. However, critics argue that these increased rates of citation do not necessarily imply that the articles are actually being read, as citations presumably could occur after review of only the abstract, which is usually publicly available for all journals[16].

At this time, it does appear that the rise of open access has promoted the dissemination of medical research in resource-poor countries. The cost of traditional journal subscriptions is a substantial burden on institutions in the developing world, which are often unable to afford the high cost of Western scientific journals[11]. One study compared the reference lists of papers by researchers in India with those of papers by researchers in Switzerland and demonstrated that the Indian researchers were more likely to cite open access articles and less likely to cite articles published in expensive journals[11]. Similarly, a study that specifically examined the effect of open access in the developing world demonstrated that open access has had a substantially greater influence in the developing world than in more affluent countries and that it has resulted in a modest but clearly positive effect on global participation in science[23].

While some argue that immediate access to the scientific literature has the potential to improve clinical outcomes, these ideas are empirical and are not backed by scientific evidence at the present time. We are aware of only one study that has specifically addressed this question[24]. In that investigation, mental health professionals in the field of clinical psychotherapy were asked to read an article that was distributed under four different conditions: no citation, normal citation, linked citation (at a cost), or free access citation. While those who were given free access were more likely to read the article, no changes in clinical practice were observed.

In rebuttal to the advocates who have emphasized the potential advantages of open access, critics have cited numerous potential pitfalls. For example, many have argued that open access will decrease the quality of the scientific literature without realizing any of the benefits described above. In particular, some have argued that open access journals have the potential to threaten the standard peer-review process and to lower quality-control standards. For example, when open access first originated in the 1990s, there were doubts about the legitimacy of these new journals[19]. There were concerns that increased article availability would cause subscribers to cancel their journal subscriptions, which threatened to undermine traditional academic publishing and to lower the quality of academic peer review[19]. However, this has not proven to be the case. Surveys of researchers typically have shown that perceived journal quality is the most important factor for journal selection, regardless of open access or author fees[25]. A direct comparison of open access and subscription-based journals founded within the past ten years demonstrated no differences in terms of quality or impact[19].

Other concerns regarding open access are related to the article-processing fees that are charged by most open access journals. From the journal's perspective, processing fees are necessary to cover the costs incurred in association with the publishing process. However, some have suggested that this arrangement represents a potential conflict of interest given that payment for publication could, in theory, influence a journal's motivation to accept or reject a manuscript[25]. From our review, the average article-processing fee for open access orthopaedic journals is $1070 (range, $150 to $3000). Others have objected to article-processing fees on the grounds that they could cause research funds to be diverted toward the payment of publishing fees instead of the performance of scientific research[3]. For example, Frank estimated that if open access became the standard, Cornell University would require an additional $1.5 million and Harvard Medical School would require an additional $13.5 million to cover the publication fees associated with their annual article-publication rates[26]. While current open access models do transfer the cost of publication from university libraries to authors (and their research grants), the overall cost is likely to be substantially lower with open access.

Finally, the open access model has been criticized for its potential to spawn "predatory publishers," which are for-profit companies that produce "low impact, low oversight" journals with little impact or visibility[10]. Some have described these publications as counterfeit journals given that they collect publishing fees while exploiting inexperienced authors who are motivated to publish the results of their research. Many of these journals are characterized by marketing techniques that can include "spamming" researchers to solicit manuscripts while promising rapid review and publication[27]. It has since been shown that some of these journals have falsified editorial boards and have even plagiarized manuscripts[15,27]. More recently, an investigator submitted an intentionally flawed sham manuscript to 304 open access journals and found that more than half offered publication without detecting the flaws and that approximately 60% of the decisions were made without any sign of peer review[28]. In response to the presence of these publishers, Jeffrey Beall, an academic librarian at the University of Colorado Denver, has posted a list of potential, possible, or probably predatory publishers (http://scholarlyoa.com/publishers/) and journals (http://scholarlyoa.com/individual-journals/). The scientific community must be aware of these journals, and orthopaedic surgeons should exercise caution when

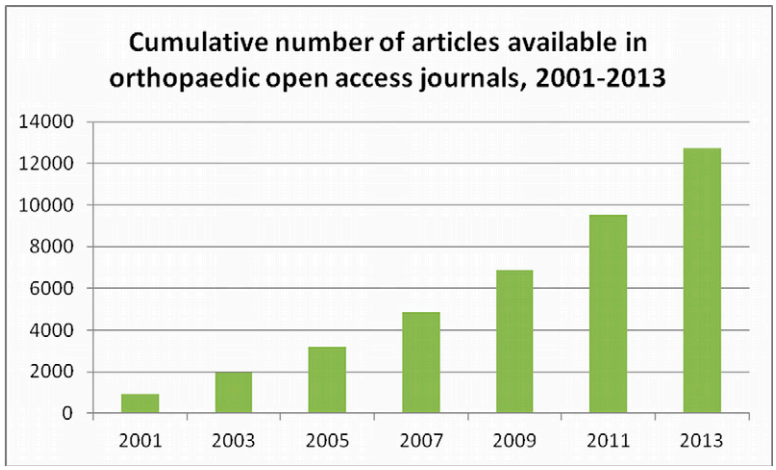

Fig. 1
Bar graph showing the cumulative number of articles available in orthopaedic open access journals, 2001 to 2013.

reading, referencing, or submitting manuscripts to unfamiliar journals.

Open Access in Orthopaedic Surgery

The number of open access journals is expanding for all specialties, including orthopaedic surgery. The Directory of Open Access Journals (http://www.doaj.org/) currently lists nearly 10,000 open access journals with >1.5 million freely available articles, and recent estimates have suggested that, in 2011, as many as 17% of published scientific articles were in immediate (12%) or delayed (5%) open access journals[3]. We are not aware of any peer-reviewed study that has specifically examined orthopaedic open access journals, but, using a variety of sources, we compiled a list of forty-two English-language open access publications focused on orthopaedic topics (Table I). In addition, by collecting information about the first year of publication, the number of issues published per year, and the number of articles per issue, we estimated the cumulative number of articles available in open access orthopaedic journals from 2001 to 2013 (Fig. 1).

Given that orthopaedic treatment can vary widely between countries and regions, our profession stands to benefit from the globalization of research and outcomes. However, established subscription-based journals may have a preference for research performed in North American countries such as the United States and Canada[29]. As surgeons, we should welcome high-quality research from developing nations to the extent that it is applicable to our practice. Open access provides the platform through which our surgical colleagues in the developing world can report their own experiences regarding the development of novel techniques and the treatment of conditions not otherwise seen in Western countries. These advantages are in addition to the known benefit of increased access to the literature among clinicians practicing in the developing world.

The Future

The trend toward open access publishing has been firmly established over the past decade and shows no sign of reversing. As such, we must be prepared to embrace and integrate open access publishing in a way that supports our science, encourages our researchers, and benefits our patients. Like any new technology, open access is not without its faults, and critics have appropriately raised concerns about academic integrity and profiteering by certain publishers. By understanding these risks and committing to improvement, open access has the potential to advance our field at a rapid pace and to bring orthopaedic research to a wider audience.

As described in the illustrative scenario that opens this review, many orthopaedic surgeons may wonder about the legitimacy of newer open access journals. Before submitting a manuscript to an open access journal for publication, one should evaluate the publication on the basis of the following criteria. First, one should check the publisher and editorial board for reputable names and colleagues who may be recognized from other publications. Next, one should search for the journal's title at http://www.doaj.org/ and determine its impact factor as a secondary representation of overall distribution, recognizing that these benchmarks are not absolute reflections of journal or research quality. One should also visit PubMed as well as the journal's archives to ensure that articles are published in a timely fashion and are actually freely available for download, consistent with open access guidelines. Once an article has been accepted for publication, one should confirm that the peer-review process has been completed and request to see the reviewer comments, even if the article was accepted without edits. If a journal meets these requirements and has a reasonable article-processing fee (average fee for orthopaedic journals, $1070; range, $150 to $3000), one can feel comfortable proceeding with publication. By adhering to these suggestions, we can improve the quality of the literature while benefitting our colleagues and patients. Instead of simply seeking to publish quickly, we encourage orthopaedic researchers to focus on publishing their research in journals that fulfill our moral commitments to wide dissemination and academic integrity.

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References

1. Wolpert AJ. For the sake of inquiry and knowledge—the inevitability of open access. N Engl J Med. 2013 Feb 28;368(9):785-7.

2. Laakso M, Welling P, Bukvova H, Nyman L, Björk BC, Hedlund T. The development of open access journal publishing from 1993 to 2009. PLoS One. 2011;6(6):e20961. Epub 2011 Jun 13.

3. Laakso M, Björk BC. Anatomy of open access publishing: a study of longitudinal development and internal structure. BMC Med. 2012 Oct 22;10:124.

4. Björk BC, Welling P, Laakso M, Majlender P, Hedlund T, Gudnason G. Open access to the scientific journal literature: situation 2009. PLoS One. 2010 Jun 23;5(6):e11273.

5. Creative commons. Creative commons license. http://creativecommons.org/licenses/by-nc-nd/3.0/. Accessed 2013 Oct 23.

6. Crawford W. Open access: what you need to know now. Chicago: American Library Association; 2011.

7. Tenopir C, King DW, Bush A. Medical faculty's use of print and electronic journals: changes over time and in comparison with scientists. J Med Libr Assoc. 2004 Apr;92(2):233-41.

8. Van Noorden R. Open access: The true cost of science publishing. Nature. 2013 Mar 28;495(7442):426-9.

9. Open sesame. The economist. 2012 Apr 14. http://www.economist.com/node/21552574. Accessed 2013 Oct 23.

10. Shea N, Prasad V. Open issues with open access publication. Am J Med. 2013 Jul;126(7):563-4.

11. Gaule P. Access to scientific literature in India. J Am Soc Inf Sci Technol. 2009;60(12):2548-53.

12. McLellan F. US bill says government funded work must be open access. The bill also wants to break up and redraw the rules on scientific publishing. Lancet. 2003 Jul 5;362(9377):52.

13. Parker M. The ethics of open access publishing. BMC Med Ethics. 2013 Mar 22;14:16.

14. Eysenbach G. Citation advantage of open access articles. PLoS Biol. 2006 May;4(5):e157. Epub 2006 May 16.

15. Beall J. Predatory publishers are corrupting open access. Nature. 2012 Sep 13;489(7415):179.

16. Davis PM. Open access, readership, citations: a randomized controlled trial of scientific journal publishing. FASEB J. 2011 Jul;25(7):2129-34. Epub 2011 Mar 30.

17. Davis PM, Walters WH. The impact of free access to the scientific literature: a review of recent research. J Med Libr Assoc. 2011 Jul;99(3):208-17.

18. Nieder C, Dalhaug A, Aandahl G. Correlation between article download and citation figures for highly accessed articles from five open access oncology journals. Springerplus. 2013 Dec;2(1):261. Epub 2013 Jun 13.

19. Björk BC, Solomon D. Open access versus subscription journals: a comparison of scientific impact. BMC Med. 2012 Jul 17;10:73.

20. Lansingh VC, Carter MJ. Does open access in ophthalmology affect how articles are subsequently cited in research? Ophthalmology. 2009 Aug;116(8):1425-31. Epub 2009 Jul 09.

21. Davis PM. Does open access lead to increased readership and citations? A randomized controlled trial of articles published in APS journals. Physiologist. 2010 Dec;53(6):197, 200-1.

22. Davis PM, Lewenstein BV, Simon DH, Booth JG, Connolly MJ. Open access publishing, article downloads, and citations: randomised controlled trial. BMJ. 2008 Jul 31;337:a568.

23. Evans JA, Reimer J. Open access and global participation in science. Science. 2009 Feb 20;323(5917):1025.

24. Hardisty DJ, Haaga DA. Diffusion of treatment research: does Open Access matter? J Clin Psychol. 2008 Jul;64(7):821-39.

25. Schroter S, Tite L, Smith R. Perceptions of open access publishing: interviews with journal authors. BMJ. 2005 Apr 2;330(7494):756. Epub 2005 Jan 26.

26. Frank M. Open but not free—publishing in the 21st century. N Engl J Med. 2013 Feb 28;368(9):787-9.

27. Haug C. The downside of open-access publishing. N Engl J Med. 2013 Feb 28;368(9):791-3.

28. Bohannon J. Who's afraid of peer review? Science. 2013 Oct 4;342(6154):60-5.

29. Okike K, Kocher MS, Mehlman CT, Heckman JD, Bhandari M. Nonscientific factors associated with acceptance for publication in The Journal of Bone and Joint Surgery (American Volume). J Bone Joint Surg Am. 2008 Nov;90(11):2432-7.