Clin Orthop Relat Res (2015) 473:2423–2430
DOI 10.1007/s11999-015-4132-1

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

SURVEY

The 50 Most-cited Articles in Orthopaedic Surgery From Mainland China

Zhiwei Jia MD, Fan Ding MD, Yaohong Wu MD, Qing He MD, Dike Ruan MD, PhD

Received: 8 October 2014 / Accepted: 5 January 2015 / Published online: 15 January 2015

Abstract

Background Citation analysis has been widely used to evaluate the impact of articles in medical and surgical specialties. Although China is the most populous country in the world, and although more than 50,000 orthopaedic surgeons practice there, to our knowledge no formal citation analysis of Chinese orthopaedic articles has been performed.

Questions/purposes We identified the 50 most-cited orthopaedic articles from mainland China and evaluated these articles in terms of their language of publication, source journals, and topics.

Methods Science Citation Index Expanded was searched in July 31, 2014 for citations of articles published in 70 selected journals since the inception of the database. The 50 most-cited orthopaedic articles originating in mainland China were identified. Basic information, including title, authors, year of publication, article type, journal in which the work was published, city, institution, number of citations, decade published, and topic or subspecialty of the research were recorded.

Results The number of citations for the top 50 papers ranged from 181 to 31 (mean, 52). These articles were published between 1981 and 2010. The decade of 2000 to 2009 was the most prolific, with 36 of the top 50 articles published during this time. All articles were written in English and they were published in a total of 16 journals. The journal *Spine* published the largest number of articles (12), followed by *Clinical Orthopaedics and Related Research®* (seven). The journal *Lancet* had the highest impact factor (39.207 for 2013) among any of the journals that published articles we identified. The top 50 articles originated mainly from Beijing (16) and Shanghai (12), with basic research being the focus of the majority (27 of 50; 54%); the remaining were clinical studies. Bone was the most-investigated topic in basic research; the spine was the most-common topic among the identified clinical studies.

Conclusions The 50 most-cited articles that we identified should be considered influential, although a large gap remains between mainland China and the global orthopaedic community in terms of citations per article. Nevertheless, insofar as the most-recent decade of our survey generated the most articles in this top-50 list, we would characterize mainland China's effect on musculoskeletal research as increasing, and as funding increases to programs in mainland China, we anticipate this trend will continue in the future.

Introduction

With more than 1.3 billion citizens, China is the world's most populous country, and the second-largest in land mass, with an area approximately equal to the entire

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.
All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research®* editors and board members are on file with the publication and can be viewed on request.
This work was performed at the Department of Orthopaedics, Navy General Hospital, Beijing, China.

Z. Jia, Y. Wu, Q. He, D. Ruan (✉)
Department of Orthopaedics, Navy General Hospital, No. 6, Fucheng Rd, Beijing 100048, China
e-mail: ruandikengh@163.com

F. Ding
Department of Orthopaedics, Wuhan Pu'Ai Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China

European continent. China's economy has been the world's second largest since 2010, and it continues to grow [36, 40]. In addition, there has been rapid development in the biomedical fields [14, 23, 38]. Orthopaedic surgery in China also is developing rapidly, and has made great advances in recent decades, with increasing importance and more attention in the world community [8, 18, 21, 27]. Additionally, there are more than 50,000 Chinese orthopaedic surgeons according to 2010 statistical data [20]. Owing to its vast population and emerging status, mainland China is becoming a leading force in medical research, including orthopaedics [28, 32, 39].

However, the impact of orthopaedic studies from mainland China has not been investigated, to our knowledge. There are many methods to evaluate the influence of a scientific article; the use of that article by other researchers is one such measure, since it indicates the contributing effect of a previous work on ongoing research. Citation analysis has been widely used to evaluate the academic importance of an article [7, 11, 12]. This bibliometric approach examines the frequency and patterns of citations in articles. The number of citations received by an article is an indicator of its scientific impact and provides a useful approach for evaluating a paper's influence in its field [17, 37]. Citation analyses have been performed in orthopaedic surgery [17, 19] and its subspecialties, including pediatric orthopaedics [16], fracture surgery [1], shoulder surgery [25], foot and ankle surgery [3], spine surgery [24], hand surgery [15], joint arthroplasty [13], and arthroscopy [6]. However, there were no orthopaedic articles from China included in previous "most-cited" studies [17, 19], and as far as we know, no study has been performed specifically to analyze the most-cited papers in orthopaedic surgery from mainland China.

In light of this, we therefore sought to (1) identify the 50 most-cited orthopaedic articles originating in mainland China and (2) analyze these articles in terms of their language of publication, source journals, and topics.

Methods

In July 31, 2014, we performed a citation search using the Science Citation Index Expanded of the ISI Web of Science (Thomson Reuters, Philadelphia, PA, USA), a method that has been used in similar studies [16, 17, 24, 30]. There were 67 journals under the subject category of "Orthopedics" in *Journal Citation Reports* for 2013. Additionally, we also searched three leading journals in clinical medicine, *The New England Journal of Medicine*, *The Lancet*, and *The Journal of the American Medical Association*, because of the increasing number of Chinese-authored articles appearing in these respected journals [38]. Therefore, 70 journals were used to identify the most-cited articles in our study (Appendix 1).

Using a previous protocol from similar studies [16, 17, 19], articles from the 70 journals were ranked based on the number of citations. To exclude articles written outside mainland China, a filter of "Countries/territories" was applied first by choosing "Peoples R China" in searching the ISI Web of Science. Each article next was evaluated and articles without a primary address or a reprint address from mainland China were excluded. This process excluded articles originating outside mainland China, and also prevented articles with one or more Chinese coauthors from inclusion in our study based solely on their names.

The 50 most-cited articles from mainland China were retrieved and reviewed. Following the methods of previous studies [16, 17], basic information was collected, including the title, authors, year of publication, article type, source journal of the article, city, institution, number of citations, decade published, and topic or subspecialty of the research.

Results

The top 50 papers and their corresponding number of citations were determined (Table 1); the number of citations for the top 50 papers ranged from 181 to 31 (mean, 52). The oldest paper in our study collection was written in 1981 and ranked 12th, while the most recent paper was written in 2010, and ranked 47th. The most articles were written in the 2000s (n = 36; 72%), followed by the 1990s (n = 8; 16%), the 1980s (n = 4; 8%) and 2010 (n = 2; 4%).

All articles in the top 50 were published in English. The articles were published in 16 of the 70 journals (Table 2), with most articles published in *Spine* (n = 12; 24%), followed by *Clinical Orthopaedics and Related Research®* (n = 7; 14%), *The Journal of Hand Surgery* (n = 5; 10%), *The Journal of Bone & Joint Surgery, American Volume* (n = 4; 8%), and *International Orthopaedics* (n = 4; 8%). *Lancet* had the highest impact factor among any of the journals that published the articles we identified, at 39.207, in 2013 (Table 2).

The top 50 articles originated from 11 Chinese cities (Table 3). The number of articles by city of origin was Beijing (n = 16; 32%), followed by Shanghai (n = 12; 24%), and Nantong (n = 8; 16%). There were 28 institutions responsible for the top-cited papers. Institutions associated with more than one paper were the Affiliated Hospital of Nantong University (n = 8; 16%), Peking University Third Hospital (n = 6; 12%), Xinhua Hospital (n = 5; 10%), 304th Hospital (n = 4; 8%), Shanghai Sixth People's Hospital (n = 3; 6%), and Jishuitan Hospital (n = 2; 4%) (Table 4).

Five first authors accounted for 18 of the 50 papers (36%). The top first author was JB Tang, with six

Table 1. The top 50 articles in orthopaedics from mainland China

Rank	Article	Number of citations
1	Sung HW, Kuo DP, Shu WP, Chai YB, Liu CC, Li SM. Giant-cell tumor of bone: analysis of two hundred and eight cases in Chinese patients. *J Bone Joint Surg Am*. 1982; 64:755–761.	181
2	Tang N, Song WX, Luo J, Haydon RC, He TC. Osteosarcoma development and stem cell differentiation. *Clin Orthop Relat Res*. 2008;466: 2114–2130.	92
3	Peng B, Wu W, Hou S, Li P, Zhang C, Yang Y. The pathogenesis of discogenic low back pain. *J Bone Joint Surg Br*. 2005;87:62–67.	90
4	Tang JB. Clinical outcomes associated with flexor tendon repair. *Hand Clin*. 2005;21:199–210.	83
5	Peng B, Hao J, Hou S, Wu W, Jiang D, Fu X, Yang Y. Possible pathogenesis of painful intervertebral disc degeneration. *Spine*. 2006;31:560–566.	83
6	Yan H, Yu C. Repair of full-thickness cartilage defects with cells of different origin in a rabbit model. *Arthroscopy*. 2007;23:178–187.	73
7	Gu YD, Ma MK. Use of the phrenic nerve for brachial plexus reconstruction. *Clin Orthop Relat Res*. 1996;323:119–121.	71
8	Zhang YG, Guo X, Xu P, Kang LL, Li J. Bone mesenchymal stem cells transplanted into rabbit intervertebral discs can increase proteoglycans. *Clin Orthop Relat Res*. 2005;430:219–226.	68
9	Tan M, Wang H, Wang Y, Zhang G, Yi P, Li Z, Wei H, Yang F. Morphometric evaluation of screw fixation in atlas via posterior arch and lateral mass. *Spine*. 2003;28:888–895.	68
10	Li GP, Zhang SD, Chen G, Chen H, Wang AM. Radiographic and histologic analyses of stress fracture in rabbit tibias. *Am J Sports Med*. 1985;13:285–294.	66
11	Liao SS, Guan K, Cui FZ, Shi SS, Sun TS. Lumbar spinal fusion with a mineralized collagen matrix and rhBMP-2 in a rabbit model. *Spine*. 2003;28:1954–1960.	65
12	Zhong-Wei C, Meyer VE, Kleinert HE, Beasley RW. Present indications and contraindications for replantation as reflected by long-term function results. *Orthop Clin North Am*. 1981;12:849–870.	64
13	Zhang X, Mao Z, Yu C. Suppression of early experimental osteoarthritis by gene transfer of interleukin-1 receptor antagonist and interleukin-10. *J Orthop Res*. 2004;22:742–750.	61
14	Holmes A, Wang C, Han ZH, Dang GT. The range and nature of flexion-extension motion in the cervical spine. *Spine*. 1994;19:2505–2510.	57
15	Lianxu C, Hongti J, Changlong Y. NF-kappaBp65-specific siRNA inhibits expression of genes of COX-2, NOS-2 and MMP-9 in rat IL-1beta-induced and TNF-alpha-induced chondrocytes. *Osteoarthritis Cartilage*. 2006;14:367–376.	54
16	Hou S, Hu R, Shi Y. Pedicle morphology of the lower thoracic and lumbar spine in a Chinese population. *Spine*. 1993;18:1850–1855.	53
17	Wu X, Zhuang S, Mao Z, Chen H. Microendoscopic discectomy for lumbar disc herniation: surgical technique and outcome in 873 consecutive cases. *Spine*. 2006;31:2689–2694.	49
18	Wang DL, Jiang SD, Dai LY. Biologic response of the intervertebral disc to static and dynamic compression in vitro. *Spine*. 2007;32:2521–2528.	49
19	Zhen W, Yaotian H, Songjian L, Ge L, Qingliang W. Giant-cell tumour of bone: the long-term results of treatment by curettage and bone graft. *J Bone Joint Surg Br*. 2004;86:212–216.	49
20	Wang Q, Zhong S, Ouyang J, Jiang L, Zhang Z, Xie Y, Luo S. Osteogenesis of electrically stimulated bone cells mediated in part by calcium ions. *Clin Orthop Relat Res*. 1998;348:259–268.	48
21	Tang JB, Wang B, Chen F, Pan CZ, Xie RG. Biomechanical evaluation of flexor tendon repair techniques. *Clin Orthop Relat Res*. 2001;386:252–259.	47
22	Zhao F, Pollintine P, Hole BD, Dolan P, Adams MA. Discogenic origins of spinal instability. *Spine*. 2005;30:2621–2630.	47
23	Wu J, Qiu Y, Zhang L, Sun Q, Qiu X, He Y. Association of estrogen receptor gene polymorphisms with susceptibility to adolescent idiopathic scoliosis. *Spine*. 2006;31:1131–1136.	46
24	Jin DD, Qu DB, Chen JT, Zhang H. One-stage anterior interbody autografting and instrumentation in primary surgical management of thoracolumbar spinal tuberculosis. *Eur Spine J*. 2004;13:114–1121.	45
25	Chen LX, Lin L, Wang HJ, Wei XL, Fu X, Zhang JY, Yu CL. Suppression of early experimental osteoarthritis by in vivo delivery of the adenoviral vector-mediated NF-kappaBp65-specific siRNA. *Osteoarthritis Cartilage*. 2008;16:174–184.	45
26	Tang JB, Cao Y, Zhu B, Xin KQ, Wang XT, Liu PY. Adeno-associated virus-2-mediated bFGF gene transfer to digital flexor tendons significantly increases healing strength: an in vivo study. *J Bone Joint Surg Am*. 2008;90:1078–1089.	44

Table 1. continued

Rank	Article	Number of citations
27	Tang JB, Zhang Y, Cao Y, Xie RG. Core suture purchase affects strength of tendon repairs. *J Hand Surg Am*. 2005;30:1262–1266.	44
28	Liu SL, Ho TC. The role of venous hypertension in the pathogenesis of Legg-Perthes disease: a clinical and experimental study. *J Bone Joint Surg Am*. 1991;73:194–200.	43
29	Dai L. Disc degeneration and cervical instability: correlation of magnetic resonance imaging with radiography. *Spine*. 1998;23:1734–1738.	43
30	Sun Y, Feng Y, Zhang CQ, Chen SB, Cheng XG. The regenerative effect of platelet-rich plasma on healing in large osteochondral defects. *Int Orthop*. 2010;34:589–597.	43
31	Peng B, Hou S, Wu W, Zhang C, Yang Y. The pathogenesis and clinical significance of a high-intensity zone (HIZ) of lumbar intervertebral disc on MR imaging in the patient with discogenic low back pain. *Eur Spine J*. 2006;15:583–587.	42
32	Cao Y, Zhu B, Xie RG, Tang JB. Influence of core suture purchase length on strength of four-strand tendon repairs. *J Hand Surg Am*. 2006;31:107–112.	42
33	Shen X, Wan C, Ramaswamy G, Mavalli M, Wang Y, Duvall CL, Deng LF, Guldberg RE, Eberhart A, Clemens TL, Gilbert SR. Prolyl hydroxylase inhibitors increase neoangiogenesis and callus formation following femur fracture in mice. *J Orthop Res*. 2009;27:1298–1305.	41
34	Tang JB, Xu Y, Ding F, Wang XT. Tendon healing in vitro: promotion of collagen gene expression by bFGF with NF-kappaB gene activation. *J Hand Surg Am*. 2003;28:215–220.	40
35	Tang JB, Shi D, Zhang QG. Biomechanical and histologic evaluation of tendon sheath management. *J Hand Surg Am*. 1996;21:900–908.	39
36	Sung HW, Shu WP, Wang HM, Yuai SY, Tsai YB. Surgical treatment of primary tumors of the sacrum. *Clin Orthop Relat Res*. 1987;215:91–98.	39
37	Tang TT, Lu B, Yue B, Xie XH, Xie YZ, Dai KR, Lu JX, Lou JR. Treatment of osteonecrosis of the femoral head with hBMP-2-gene-modified tissue-engineered bone in goats. *J Bone Joint Surg Br*. 2007;89:127–129.	38
38	Xie RG, Zhang S, Tang JB, Chen F. Biomechanical studies of 3 different 6-strand flexor tendon repair techniques. *J Hand Surg Am*. 2002;27:621–627.	37
39	Wang C, Yan M, Zhou HT, Wang SL, Dang GT. Open reduction of irreducible atlantoaxial dislocation by transoral anterior atlantoaxial release and posterior internal fixation. *Spine*. 2006;31:E306–E313.	37
40	Ruan D, He Q, Ding Y, Hou L, Li J, Luk KD. Intervertebral disc transplantation in the treatment of degenerative spine disease: a preliminary study. *Lancet*. 2007;369: 993–999.	36
41	Dai LY. Orientation and tropism of lumbar facet joints in degenerative spondylolisthesis. *Int Orthop*. 2001;25:40–42.	36
42	Dai LY, Jiang LS, Jiang SD. Posterior short-segment fixation with or without fusion for thoracolumbar burst fractures: a five to seven-year prospective randomized study. *J Bone Joint Surg Am*. 2009;91:1033–1041.	36
43	Dai LY. Remodeling of the spinal canal after thoracolumbar burst fractures. *Clin Orthop Relat Res*. 2001;382:119–123.	35
44	Cao J, Li S, Shi Z, Yue Y, Sun J, Chen J, Fu Q, Hughes CE, Caterson B. Articular cartilage metabolism in patients with Kashin-Beck Disease: an endemic osteoarthropathy in China. *Osteoarthritis Cartilage*. 2008;16:680–688.	35
45	Mathieu F, Begaux F, Lan ZY, Suetens C, Hinsenkamp M. Clinical manifestations of Kashin-Beck disease in Nyemo Valley, Tibet. *Int Orthop*. 1997;21:151–156.	34
46	Zhiquan A, Bingfang Z, Yeming WM, Chi Z, Peiyan H. Minimally invasive plating osteosynthesis (MIPO) of middle and distal third humeral shaft fractures. *J Orthop Trauma*. 2007;21:628–633.	33
47	Wang J, Zhou Y, Zhang ZF, Li CQ, Zheng WJ, Liu J. Comparison of one-level minimally invasive and open transforaminal lumbar interbody fusion in degenerative and isthmic spondylolisthesis grades 1 and 2. *Eur Spine J*. 2010;19:1780–1784.	33
48	Dai LY, Jiang LS. Single-level instrumented posterolateral fusion of lumbar spine with beta-tricalcium phosphate versus autograft: a prospective, randomized study with 3-year follow-up. *Spine*. 2008;33:1299–1304.	33
49	Sun K, Tian S, Zhang J, Xia C, Zhang C, Yu T. Anterior cruciate ligament reconstruction with BPTB autograft, irradiated versus non-irradiated allograft: a prospective randomized clinical study. *Knee Surg Sports Traumatol Arthrosc*. 2009;17:464–474.	32
50	Tian NF, Xu HZ. Image-guided pedicle screw insertion accuracy: a meta-analysis. *Int Orthop*. 2009;33:895–903.	31

Table 2. Journals publishing orthopaedics articles by authors from mainland China

Journal	Number of articles	Impact factor
Spine	12	2.447
Clinical Orthopaedics and Related Research®	7	2.882
The Journal of Hand Surgery	5	1.665
The Journal of Bone & Joint Surgery, American Volume	4	4.309
International Orthopaedics	4	2.019
European Spine Journal	3	2.473
Osteoarthritis and Cartilage	3	4.663
The Journal of Bone & Joint Surgery, British Volume	3	2.801
Journal of Orthopaedic Research	2	2.972
The Lancet	1	39.207
Arthroscopy	1	3.191
The American Journal of Sports Medicine	1	4.699
Knee Surgery, Sports Traumatology, Arthroscopy	1	2.837
Journal of Orthopaedic Trauma	1	1.540
Hand Clinics	1	1.071
Orthopedic Clinics of North America	1	1.696

Table 3. Cities of origin of articles

City	Number of articles
Beijing	16
Shanghai	12
Nantong	8
Guangzhou	3
Xi'an	3
Nanjing	2
Chongqing	2
Qingdao	1
Hangzhou	1
Wenzhou	1
Lhasa	1

Table 4. Institutions associated with more than one article

Institution (city)	Number of articles
Affiliated Hospital of Nantong University (Nantong)	8
Peking University Third Hospital (Beijing)	6
Xinhua Hospital (Shanghai)	5
304th Hospital (Beijing)	4
Shanghai Sixth People's Hospital (Shanghai)	3
Jishuitan Hospital (Beijing)	2

Table 5. Classification of basic research by topic

Topic	Number of articles
Bone	9
Tendon	7
Articular cartilage	6
Intervertebral disc	5

publications on the list, followed by LY Dai (n = 5; 10%), BG Peng (n = 3; 6%), HW Sung (n = 2; 4%), and LX Chen (n = 2; 4%). Of the top 50 papers, 27 reported basic research and 23 were clinical studies. Bone (n = 9; 18%) was the most-discussed topic in basic research (Table 5) and the spine (n = 14; 28%) was the most-common topic covered in clinical studies (Table 6).

Discussion

Orthopaedic surgery research originating from mainland China has shown increasing importance in the international orthopaedic community and has gotten more attention worldwide [8, 18, 21, 27]. Although citation analysis of the top-cited articles has been performed in multiple medical fields and reported for global orthopaedics [2, 4, 9, 17, 19, 26, 29–31, 34, 35], to our knowledge no Chinese article was included among the global most-cited orthopaedic papers [17, 19], and no citation analysis evaluating the top-cited articles from mainland China has been published. We therefore sought to identify the 50 most-cited articles from mainland China, and to describe them in terms of the language the articles were published in, the journals that published them, and the main topics they covered.

Table 6. Classification of clinical studies by subspecialty

Subspecialty	Number of articles
Spine	14
Hand	3
Oncology	3
Trauma	1
Joint	1
Sports medicine	1

There are several limitations to our study. First, although a well-defined method was used to identify influential papers, important articles from mainland China that have been cited less often were not included. On the contrary, the highly cited articles do not always mean that articles are of high scientific quality. Sometimes articles are cited because they represent a disproved or failed paradigm. Second, we restricted our search to ISI-indexed orthopaedic journals in addition to a small number of high-impact general medical journals. Using this approach, we would not have identified articles published in nonindexed journals. However, it is our impression that articles in those journals, in general, would be unlikely to gain as many citations as journals on the roster we considered. Third, numerous factors influence total number of citations. Our study could not evaluate citations in textbooks, lectures, and other web-based literature [10, 19, 25]. Similarly, authors may be likely to cite articles from the journal in which they hope to publish their study [33]. Fourth, total number of citations used as a measure of impact would be expected to favor older articles that accumulate a larger number of citations with time; however, we found it interesting and somewhat counterintuitive that the most-recent decade in our search garnered the largest number of top-cited articles, This is a strong suggestion that research coming from mainland China is gaining visibility and impact in more recent years. Fifth, our study had a cross-sectional design with our search being done one time. The rank of articles on the list may change if the search is repeated at a subsequent time.

The 50 most-cited articles were published between 1981 and 2010, with the 2000s representing the most-productive decade. This result is inconsistent with trends elsewhere in orthopaedics, which have found articles from the 1980s to have garnered the most citations in one bibliometric analysis [19]. A possible explanation for this difference is that research funding has increased sharply since the 1980s, a reflection of China's growing economy in recent years [21, 27]. In other words, as biomedical research more generally (and orthopaedics specifically) have developed [8, 23, 27], the bibliometric impact of the research published there has increased.

The top 50 articles were cited between 31 and 181 times. These numbers obviously are lower than those of the global orthopaedic community, where the smallest number of citations needed to make the top 100 was 353 [19]. Based on those numbers, it is no surprise that there were no Chinese articles previously appearing in the lists of top citations [19]. Our results show there still is a need to improve the quality of Chinese research, despite its increase in quantity [8, 18]. Even so, every paper on the top-50 list from mainland China that appeared in an orthopaedic journal was likely to have improved the impact factor of the journal in which it appeared, since the orthopaedic journal with the highest impact factor in 2013 averaged between four and five citations per article (Table 2).

All the articles were written in English, probably because English is the most frequently used language in the orthopaedic literature, including orthopaedic subspecialties [1, 3, 6, 13, 16, 17, 19, 24, 25]. Moreover, the predominance of English-language articles may be one reason that fewer Chinese-authored orthopaedic articles appear in international journals compared with western countries, because writing in a foreign language may be a hindrance for Chinese researchers.

The journal that published the largest number of articles on our list was *Spine*. The top three journals, including *Spine*, *Clinical Orthopaedics and Related Research®*, and *The Journal of Hand Surgery* published almost ½ of the articles on our list. Previous studies have shown that the impact factor of the journal is the strongest predictor of citations and most of the top-cited articles were published in journals with a high impact factor [5, 17, 35]; however, this did not prove true in our study (Table 2). *The Lancet*, with only one article, was the journal with the highest impact factor (39.207), whereas the impact factor of *Spine,* with the most articles published (n = 12; 24%), was much lower (2.447). This suggests that authors who publish highly cited articles may not be motivated solely by the impact factor of a journal when considering where to submit their manuscripts; rather, other factors, including topical interest, the audience a journal reaches, and the journal's interest or lack thereof in a particular study, may influence these results [17, 19, 24, 25].

Eleven cities contributed to the top 50 list of highest-cited articles, led by Beijing, the capital city of China, followed by Shanghai. This confirms the important influence of both cities relative to orthopaedic medicine and research in mainland China. Beijing and Shanghai also have large orthopaedic communities and sufficient financial support [17, 20, 21, 30].

Our top-50 list included more basic research articles than clinical studies. Surprisingly, this finding is at odds with findings from previous studies in global orthopaedics or subspecialties [1, 3, 6, 13, 15–17, 19, 24, 25]. In Chinese

clinical research, basic science encompassed more than clinical studies, according to a study published in 2011 [14], with the average ratio of 1.3:1 (range, 0.7:1–1.5:1), which was similar to our result (1.17). There may be several reasons for the status of clinical research in mainland China. Clinical trials involving long periods of treatment and followup are highly complex and tightly regulated endeavors. Although mainland China has an advantage in population for recruitment of participants, most individuals do not have access to high-quality, Western-style healthcare [32] which helps participants join clinical trials. Insufficient funding, lack of available time, an unsupportive research environment, and a deficient clinical research teaching program may have influenced the finding of fewer clinical studies on our list from mainland China to this point [14, 22]. However, the environment is changing with respect to these issues. With the progress of medical reform [28], development of the experience and capacity for clinical trials [32, 39], and increased available funding [28, 32], we hope that future bibliometric analyses will show increased citations and more-impactful clinical research.

To our knowledge, this is the first citation analysis of the top-cited orthopaedic articles originating from mainland China. The 50 articles we identified should be considered influential based on the absolute numbers of citations they garnered. However, compared with similar lists from the specialty in aggregate, the citation numbers here show that orthopaedic research in mainland China remains lower impact than the most-cited articles in our specialty overall [19]. Nevertheless, because the latest decade was the most productive one we evaluated in terms of citation rate among articles from mainland China, and because funding is increasing for biomedical research in mainland China [28, 32], one imagines that orthopaedic research from mainland China will continue to grow in its impact on the specialty in terms of citation counts in the future.

Appendix 1. List of journals searched

Journal name
Acta Chirurgiae Orthopaedicae et Traumatologiae Cechoslovaca
Acta Orthopaedica
Acta Orthopaedica Belgica
Acta Orthopaedica et Traumatologica Turcica
Acta Ortopedica Brasileira
Archives of Orthopaedic and Trauma Surgery
Arthroscopy
BMC Musculoskeletal Disorders
Brazilian Journal of Physical Therapy
Clinical Biomechanics
Clinical Journal of Sport Medicine
Clinical Orthopaedics and Related Research®
Clinics in Podiatric Medicine and Surgery
Connective Tissue Research
Eklem Hastaliklari ve Cerrahisi
European Spine Journal
Foot & Ankle International
Foot and Ankle Clinics
Gait & Posture
Hand Clinics
Journal of Hand Therapy
Hip International
Indian Journal of Orthopaedics
Injury
International Journal of Shoulder Surgery
International Orthopaedics
Isokinetics and Exercise Science
Journal of Back and Musculoskeletal Rehabilitation
Journal of Foot and Ankle Research
Journal of Orthopaedic Research
Journal of Orthopaedic Science
Journal of Orthopaedic Surgery and Research
Journal of Orthopaedic Trauma
Journal of Pediatric Orthopedics
Journal of Pediatric Orthopedics-Part B
Journal of Physiotherapy
Journal of Plastic Surgery and Hand Surgery
Journal of Shoulder and Elbow Surgery
Journal of Spinal Disorders & Techniques
Journal of the American Podiatric Medical Association
Knee Surgery, Sports Traumatology, Arthroscopy
Operative Orthopädie und Traumatologie
Der Orthopade
Orthopaedics & Traumatology, Surgery & Research
Orthopedic Clinics of North America
Orthopedic Nursing
Orthopedics
Osteoarthritis and Cartilage
Osteologie
Physical Therapy
Prosthetics and Orthotics International
Spine
Sportverletzung-Sportschaden
The American Journal of Sports Medicine
The Bone & Joint Journal
The Journal of Arthroplasty
The Journal of Bone & Joint Surgery. American Volume

Appendix 1. continued

Appendix 1. continued

Journal name
The Journal of Bone & Joint Surgery. British Volume
The Journal of Foot & Ankle Surgery
The Journal of Hand Surgery
The Journal of Hand Surgery, European Volume
The Journal of Orthopaedic and Sports Physical Therapy
The Journal of the American Academy of Orthopaedic Surgeons
The Journal of the American Medical Association
The Knee
The Lancet
The New England Journal of Medicine
The Physician and Sportsmedicine
The Spine Journal
Zeitschrift für Orthopädie und Unfallchirurgie

References

1. Baldwin K, Namdari S, Donegan D, Kovatch K, Ahn J, Mehta S. 100 most cited articles in fracture surgery. *Am J Orthop (Belle Mead NJ)*. 2013;42:547–552.
2. Baltussen A, Kindler CH. Citation classics in critical care medicine. *Intensive Care Med*. 2004;30:902–910.
3. Bayley M, Brooks F, Tong A, Hariharan K. The 100 most cited papers in foot and ankle surgery. *Foot (Edinb)*. 2014;24:11–16.
4. Brandt JS, Downing AC, Howard DL, Kofinas JD, Chasen ST. Citation classics in obstetrics and gynecology: the 100 most frequently cited journal articles in the last 50 years. *Am J Obstet Gynecol*. 2010;203:355.e1–7.
5. Callaham M, Wears RL, Weber E. Journal prestige, publication bias, and other characteristics associated with citation of published studies in peer-reviewed journals. *JAMA*. 2002;287:2847–2850.
6. Cassar Gheiti AJ, Downey RE, Byrne DP, Molony DC, Mulhall KJ. The 25 most cited articles in arthroscopic orthopaedic surgery. *Arthroscopy*. 2012;28:548–564.
7. Cheek J, Garnham B, Quan J. What's in a number? Issues in providing evidence of impact and quality of research(ers). *Qual Health Res*. 2006;16:423–435.
8. Cheng T. Research in orthopaedics from China has thrived over the last decade: a bibliometric analysis of publication activity. *Orthop Traumatol Surg Res*. 2012;98:253–258.
9. Coelho DH, Edelmayer LW, Fenton JE. A century of citation classics in otolaryngology-head and neck surgery journals revisited. *Laryngoscope*. 2014;124:1358–1362.
10. Dumont JE. The bias of citations. *Trends Biochem Sci*. 1989;14:327–328.
11. Garfield E. Citation analysis as a tool in journal evaluation. *Science*. 1972;178:471–479.
12. Gisvold SE. Citation analysis and journal impact factors: is the tail wagging the dog? *Acta Anaesthesiol Scand*. 1999;43:971–973.
13. Holzer LA, Holzer G. The 50 highest cited papers in hip and knee arthroplasty. *J Arthroplasty*. 2014;29:453–457.
14. Hu Y, Huang Y, Ding J, Liu Y, Fan D, Li T, Shou C, Fan J, Wang W, Dong Z, Qin X, Fang W, Ke Y. Status of clinical research in China. *Lancet*. 2011;377:124–125.
15. Joyce CW, Kelly JC, Carroll SM. The 100 top-cited classic papers in hand surgery. *J Plast Surg Hand Surg*. 2014;48:227–233.
16. Kavanagh RG, Kelly JC, Kelly PM, Moore DP. The 100 classic papers of pediatric orthopaedic surgery: a bibliometric analysis. *J Bone Joint Surg Am*. 2013;95:e134.
17. Kelly JC, Glynn RW, O'Briain DE, Felle P, McCabe JP. The 100 classic papers of orthopaedic surgery: a bibliometric analysis. *J Bone Joint Surg Br*. 2010;92:1338–1343.
18. Lao LF, Daubs MD, Phan KH, Wang JC. Comparative study of scientific publications in orthopedics journals originating from USA, Japan and China (2000–2012). *Acta Cir Bras*. 2013;28:800–806.
19. Lefaivre KA, Shadgan B, O'Brien PJ. 100 most cited articles in orthopaedic surgery. *Clin Orthop Relat Res*. 2011;469:1487–1497.
20. Leung KS, Ngai WK, Tian W. Orthopaedic training in China: experiences from the promotion of orthopaedic specialist training in China. *J Bone Joint Surg Br*. 2011;93:1165–1168.
21. Li Y. Chinese orthopaedic surgeons doing clinical research for international publication. *ANZ J Surg*. 2013;83:300–301.
22. Ma ZS, Wang L, Du GS, Chen XJ. What is the work environment of orthopaedic surgeons in China? *Clin Orthop Relat Res*. 2014;472:3576–3580.
23. Makris GC, Spanos A, Rafailidis PI, Falagas ME. Increasing contribution of China in modern biomedical research: statistical data from ISI Web of Knowledge. *Med Sci Monit*. 2009;15:SR15–21.
24. Murray MR, Wang T, Schroeder GD, Hsu WK. The 100 most cited spine articles. *Eur Spine J*. 2012;21:2059–2069.
25. Namdari S, Baldwin K, Kovatch K, Huffman GR, Glaser D. Fifty most cited articles in orthopedic shoulder surgery. *J Shoulder Elbow Surg*. 2012;21:1796–1802.
26. Nason GJ, Tareen F, Mortell A. The top 100 cited articles in urology: an update. *Can Urol Assoc J*. 2013;7:E16–24.
27. Nie YX, Guo J, Knight DJ, Porter DE. Orthopaedics in China. *J Bone Joint Surg Br*. 2011;93:1145–1148.
28. No authors listed. Reforming research in China. *Lancet*. 2007;369:880. DOI: http://dx.doi.org/10.1016/S0140-6736(07)60419-X.
29. Ohba N, Nakao K, Isashiki Y, Ohba A. The 100 most frequently cited articles in ophthalmology journals. *Arch Ophthalmol*. 2007;125:952–960.
30. Pagni M, Khan NR, Cohen HL, Choudhri AF. Highly cited works in radiology: the top 100 cited articles in radiologic journals. *Acad Radiol*. 2014;21:1056–1066.
31. Paladugu R, Schein M, Gardezi S, Wise L. One hundred citation classics in general surgical journals. *World J Surg*. 2002;26:1099–1105.
32. Perkovic V, Patil V, Wei L, Lv J, Petersen M, Patel A. Global randomized trials: the promise of India and China. *J Bone Joint Surg Am*. 2012;94(suppl 1):92–96.
33. Seglen PO. Why the impact factor of journals should not be used for evaluating research. *BMJ*. 1997;314:498–502.
34. Tam WW, Wong EL, Wong FC, Hui DS. Citation classics: top 50 cited articles in 'respiratory system'. *Respirology*. 2013;18:71–81.
35. Tas F. An analysis of the most-cited research papers on oncology: which journals have they been published in? *Tumour Biol*. 2014;35:4645–4649.
36. The World Bank. China East Asia & Pacific (developing only). Available at: http://data.worldbank.org/country/china. Accessed September 20, 2014.
37. To P, Atkinson CT, Lee DH, Pappas ND. The most cited articles in hand surgery over the past 20-plus years: a modern-day reading list. *J Hand Surg Am*. 2013;38:983–987.
38. Tong D, Wang L, Jiang J. Publications from China in The Lancet, NEJM, and JAMA. *Lancet*. 2013;381:1983.
39. Wang C, Liu Q. A turning point for clinical research in China? *Lancet*. 2013;382:835–836.
40. Wikipedia. China. Available at: http://en.wikipedia.org/wiki/China. Accessed September 20, 2014.