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Neurosurgical publications in China: an analysis of the web of science database

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Abstract

Background: Neurosurgery in China has made great progress. The aim of this study was to analyze neurosurgical publications by Chinese authors using the Web of Science database as a way to illustrate the current state of neurosurgery in China.

Methods: We searched the Web of Science core database for articles containing “neurosurg*” with or without an author address in “China” to obtain the set of neurosurgical publications in China and worldwide. We then extracted data from the search results to obtain information such as document type, countries/territories, organizations, publication year, title and research area. Then, we analyzed the search results of articles (document type) to generate a citation report. We identified publications by Chinese neurosurgeons that were cited more than 100 times.

Results: A total of 165,365 neurosurgical publications were identified. Among them, 10,770 were published by Chinese neurosurgeons. Chinese neurosurgical publications have increased year by year, accounting for 2 % of neurosurgical publications before 2010 and rising to 13 % from 2010 to the present. The most frequent journals for Chinese neurosurgeons differ from the most frequent journals worldwide. We identified 34 Chinese organizations that published more than 100 publications. We also identified 19 studies written by Chinese neurosurgeons that were cited more than 100 times. Basic research represents a large proportion of Chinese publications in this area, while clinical research remains a weak area. Cooperative studies were overrepresented among Chinese studies.

Conclusion: While China’s publication output in the area of neurosurgery has made great progress, significant room for improvement remains. The next step is to strengthen Chinese neurosurgical clinical studies and improve the publishing environment for Chinese neurosurgeons.

Keywords: Neurosurgery, Publications, China, Web of science

Background

For historical reasons, the field of neurosurgery has developed in China along its own unique path [1, 2]. Today’s China is more open than ever, including in academic research. Chinese neurosurgeons need to learn from their foreign counterparts, while doctors outside China also need to know what Chinese doctors have done. Publications represent the best bridge between these groups. In recent years, China doctors have begun to realize the importance of publication, and have begun to capture their discoveries and experience in publications to communicate their findings to others. As the main international academic language is English, Chinese neurosurgeons have

to publish their work in English to reach worldwide recognition. As a result, language limitations obstruct academic exchanges between Chinese doctors and those from other countries.

Chinese neurosurgeons have published a significant body of work. Thus far, Chinese neurosurgery has made significant achievements in both clinical practice and scientific research, obtaining worldwide recognition and respect. As China has the largest population in the world, it should represent the largest disease resource database, and the voices of Chinese physicians should be well represented in the academic discussion. The first task is to understand the work that has already been done by Chinese neurosurgeons and China’s current position in the field.

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The most commonly used medical biological databases—PubMed, Web of Science, and Google Scholar—each have their own strengths and weaknesses [3]. Among them, Web of Science (WoS) is a strong research database that was officially inaugurated in 2004 by the Thomson Scientific and Health Care Corporation. The WoS database not only contains the affiliations of all authors but also provides the numbers of citations of published articles. WoS provides access to Thomson Reuter’s multidisciplinary databases of bibliographic information. WoS is a powerful web interface providing access to the citation database [4]. WoS offers a significant advantage for literature reviews in some particular fields [5, 6], especially for efforts to understand overall trends [7, 8]. Previous studies have evaluated Chinese neurosurgical publications, but they only focused on local Chinese journals [9] or carried out only superficial research on Chinese neurosurgical publications [10]. The aim of this study was to comprehensively analyze neurosurgical publications in China using the WoS database.

Methods

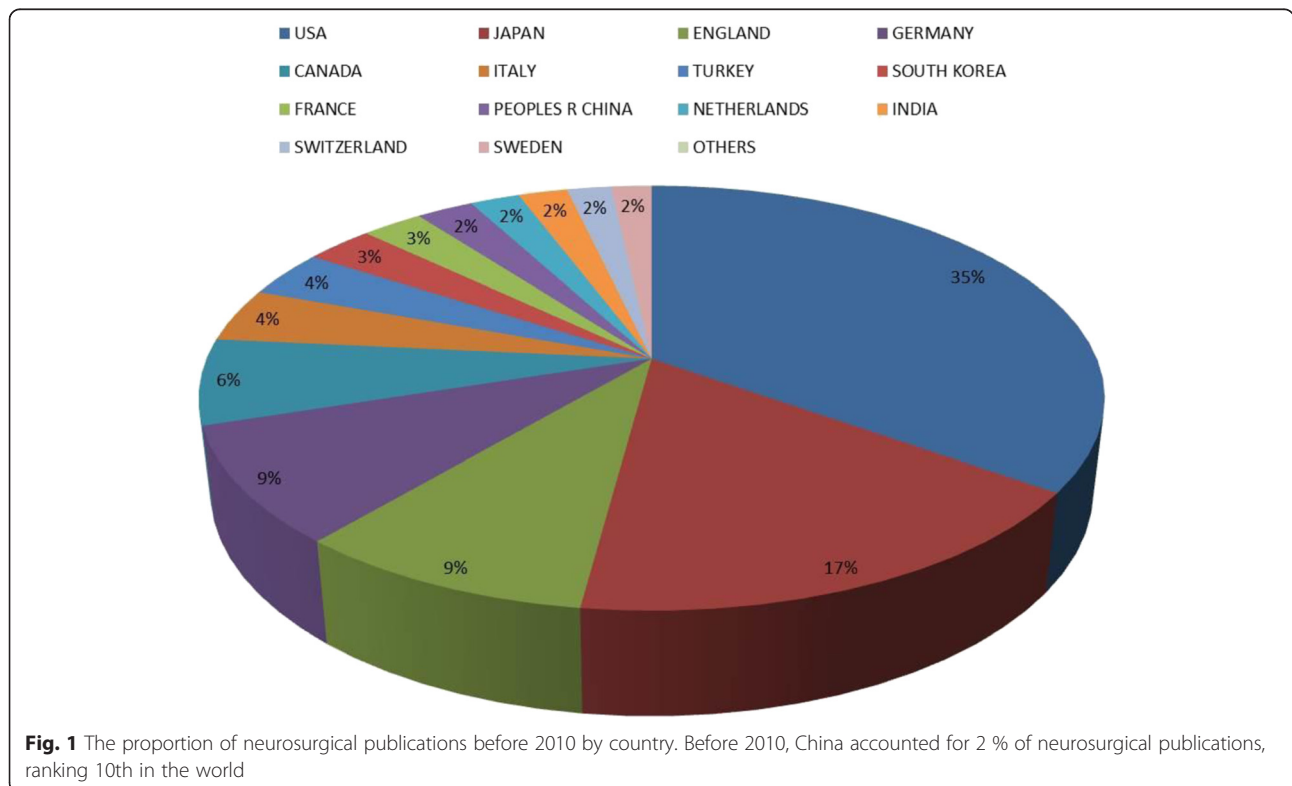
The Web of Science (WoS) database was accessed on May 4, 2015. Publications in the Web of science core collection database were searched for publications of all types with authors’ addresses containing “neurosurg*” or “surgical neurology”. The number of publications

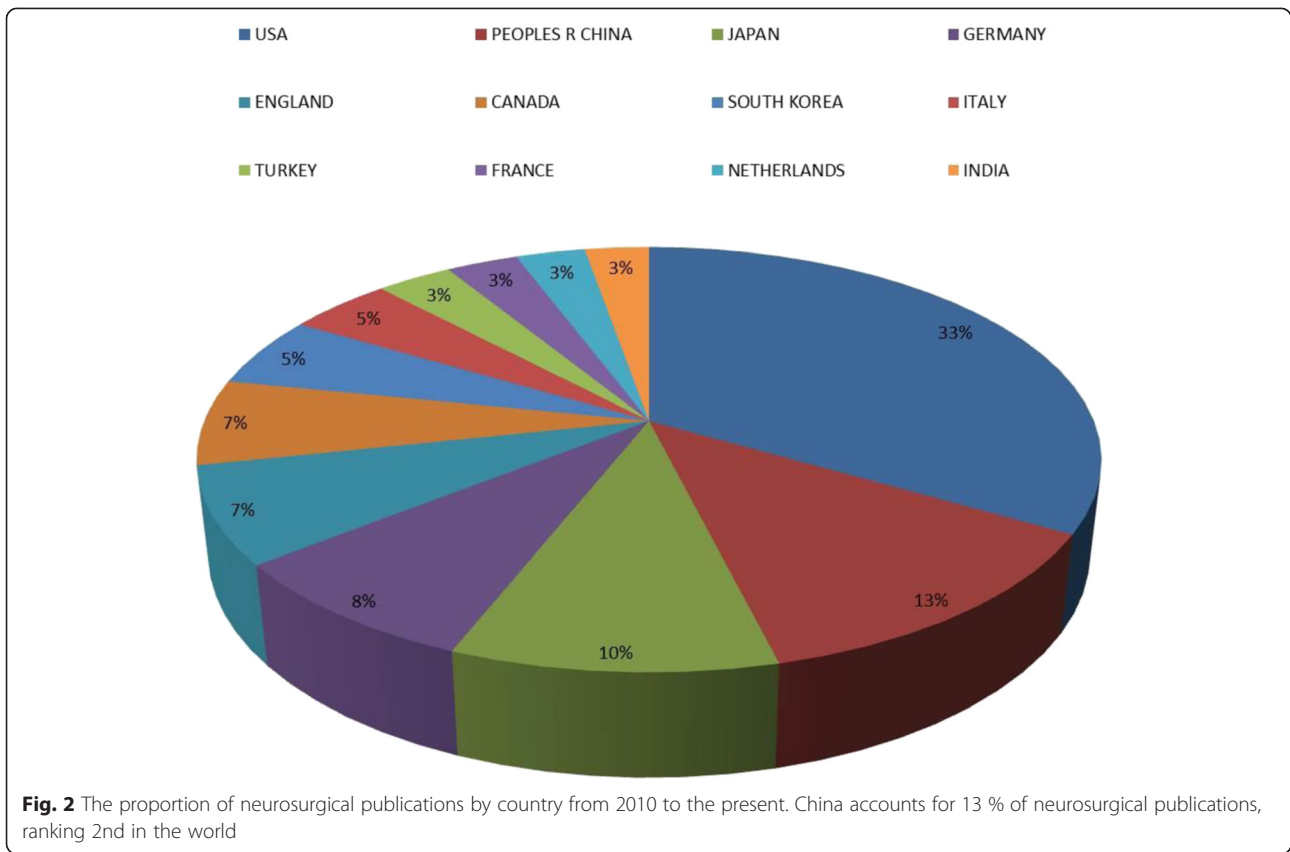
and other information was obtained. In the first stage, an international comparison of neurosurgeons’ research outputs by country was carried out. Then, the search was divided into two periods, before 2010 (1928–2009) and after 2010 (2010 to present) to extract more detailed information.

Chinese neurosurgical publications were identified using the following search strategy: ((address: neurosurg*) OR (address: surgical neurology)) AND (address: China). Data were extracted from the search results to obtain information such as document type, countries/territories, funding agencies, organizations, publication year, title and research area. Then, the search results were analyzed using the “analyze results” tool on the WoS webpage.

We only included articles in the citation report, excluding reviews, meeting abstracts, letters, editorial material and other document types. We searched for papers with Chinese corresponding authors cited more than 100 times to identify Chinese neurosurgeons playing important roles in research. We also spoke with senior experts in the neurosurgical field and manually retrieved some original documents to ensure a complete survey.

Publications from the departments/institutes of neurosurgery in China and data sources from the Web of science core collection database were searched. The types of publications included articles, letters, reviews, proceedings papers, editorial materials, and more. Analyses





included yearly research output, research output over the whole time period, WoS subject category, authors, organizations/institutes that submitted published articles, and the names of journals publishing articles.

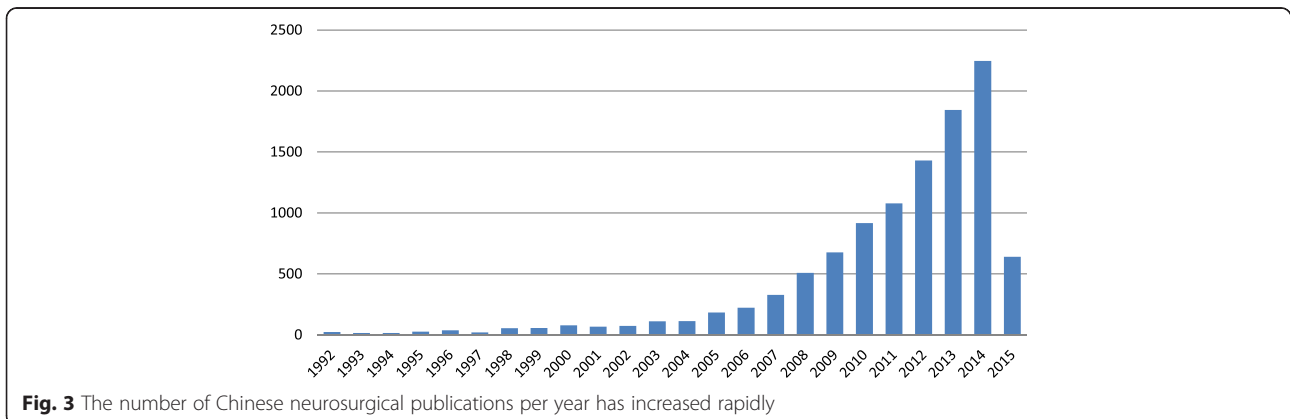
Data from WoS were exported to a Microsoft Office® Excel spreadsheet and then transferred to a Microsoft Word document. We considered the top ranked publications in each item. ANOVA, Student’s t-, and c2 tests were used to assess the statistical significance of differences in the mean citation numbers among different study periods (SPSS version 17.0; SPSS Inc., Chicago,

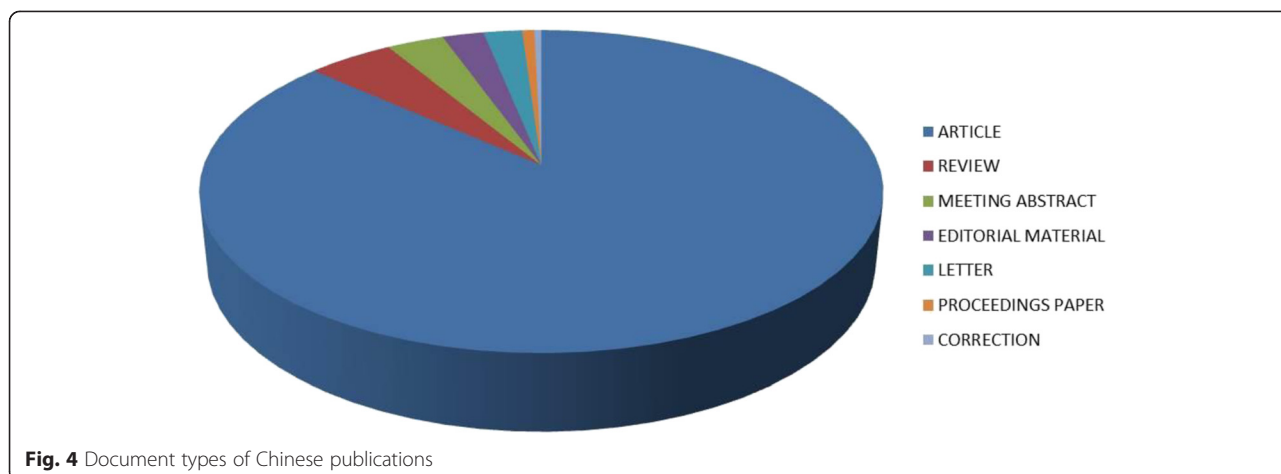
IL, USA). A p value <0.05 was considered statistically significant (2-tailed test).

Result

Proportional growth in Chinese publications

Worldwide, neurosurgical departments have been involved in a total of 165,365 publications, 61,411 of which were published since the beginning of 2010. Before 2010, Chinese neurosurgeons published only 2 % of total publications, ranking tenth in the world (Fig. 1). Chinese neurosurgical authors contributed 13 % of publications in the





period after 2010, rising to the second most productive country in the world (Fig. 2).

Chinese neurosurgeons have published a total of 10,770 publications. The number of publications has increased every year, with especially rapid growth observed in recent years (Fig. 3).

The greatest proportion of these publications are articles, accounting for more than 87 %, far more than other document types (Fig. 4).

Details of Chinese neurosurgical publications

The 10 journals most frequently publishing articles by Chinese neurosurgeons differ from those publishing articles by neurosurgeons from throughout the world (Table 1). Chinese neurosurgeons have published few articles in the most famous magazines in the field of neurosurgery, such as “Journal of Neurosurgery” and “Neurosurgery”. Instead, they have frequently published papers in general medical journals such as “Chinese Medical Journal” and “PLOS One”. Journals emphasizing basic research have also published many articles by Chinese neurosurgeons.

There are 34 Chinese organizations that have published more than 100 publications in this research area (Table 2). The most prolific is “Capital Medical University”, which has published 1287 publications, accounting for 12 % of all Chinese neurosurgical publications. Most of these organizations are universities located in central cities of Eastern China.

We identified 19 studies written by Chinese authors that have been cited more than 100 times (18 were identified from a database search, while 1 came from consulting a senior expert). The details of these studies are shown in Table 3. Most of these studies are basic research. However, some report research on clinical practice such as brain trauma, brain stem cavernous malformations, and epidemiological investigations in China. Because of China’s huge population and number of patients, the experiences and discoveries of Chinese neurosurgeons are an important part of the global knowledge base.

Research area trends

Comparing publications before and after 2010, the distribution of worldwide publications among different research

Table 1 The top 10 journals publishing Chinese’s and world neurosurgeon’s publications

Chinese neurosurgeon publications			World neurosurgeon publications		
Source Titles	Records	% of all	Source Titles	Records	% of all
Chinese medical journal	436	4.048	Journal of neurosurgery	7211	4.361
Plos ONE	309	2.869	Neurosurgery	6626	4.007
Journal of clinical neuroscience	295	2.739	Acta neurochirurgica	4785	2.894
Neural regeneration research	239	2.219	Surgical neurology	3351	2.026
Brain research	199	1.848	Childs nervous system	3158	1.91
Journal of neuro oncology	184	1.708	Neurologia medico chirurgica	3082	1.864
Acta neurochirurgica	157	1.458	Journal of clinical neuroscience	2876	1.739
Neuroscience letters	153	1.421	Neuro oncology	2542	1.537
Clinical neurology and neurosurgery	145	1.346	Epilepsia	2465	1.491
Neurological research	143	1.328	Journal of neuro oncology	2385	1.442

Table 2 Organizations who published more 100 publications in China

	Organizations	Records	% of all
1	Capital Medical University	1287	11.95
2	Fudan University	776	7.205
3	Beijing Neurosurgical Institute	667	6.193
4	Shanghai Jiao tong University	666	6.184
5	Fourth Military Medical University	594	5.515
6	China Medical University	540	5.014
7	Sichuan University	431	4.002
8	Zhejiang University	413	3.835
9	Shandong University	386	3.584
10	Second Military Medical University	375	3.482
11	Chinese University Of Hong Kong	343	3.185
12	Harbin Medical University	334	3.101
13	Third Military Medical University	331	3.073
14	China Medical University Taiwan	330	3.064
15	Tianjin Medical University	312	2.897
16	Nanjing Medical University	308	2.86
17	Southern Medical University China	307	2.851
18	Sun Yat Sen University	284	2.637
19	Suzhou University	278	2.581
20	Jilin University	272	2.526
21	Nanjing University	257	2.386
22	Prince Of Wales Hospital	248	2.303
23	Chinese Academy of Sciences	242	2.247
24	China Medical University Hospital Taiwan	242	2.247
25	Chinese Academy Of Medical Sciences Peking Union Medical College	239	2.219
26	Huazhong University of Science Technology	216	2.006
27	Central South University	212	1.968
28	Peking University	206	1.913
29	Xi An Jiaotong University	158	1.467
30	Tongji University	125	1.161
31	University of Hong Kong	122	1.133
32	Chongqing Medical University	119	1.105
33	Nantong University	117	1.086
34	Fujian Medical University	113	1.049

areas has changed somewhat. The following research areas have increased in proportion between the two periods: oncology, research experimental medicine, orthopedics, general internal medicine, cardiovascular system, cardiology, cell biology, pharmacology, and pharmacy.

At the same time, the proportions of the following research areas have decreased: neurosciences, neurology, surgery, radiology, nuclear medicine, medical imaging,

pediatrics, pathology, psychiatry and endocrinology metabolism. However, these changes are not statistically significant (Fig. 5).

As for Chinese publications, basic research areas such as cell biology, pharmacology, pharmacy, biochemistry, and molecular biology represent a higher proportion of publications compared with other countries. Clinical research areas such as neurosciences, neurology, and surgery are underrepresented among Chinese publications compared with the rest of the world (Fig. 5).

International collaborative research

Among 10,770 Chinese publications, 9385 are articles (not including reviews, meeting abstracts, letters and editorial materials). The studies by Chinese neurosurgeons represent collaborations with researchers from more than 20 countries, mostly developed countries such as the United States, Japan, Canada, Britain, Germany, and Australia (Fig. 6).

The citation report from these 9385 articles is displayed in Table 4. Among the 9385 articles, 2393 were the products of international collaborations. We find that these collaborative publications have a greater impact factor than the overall average impact factor. The average Citations per Item across all Chinese publications in this sample is 8.23, while the collaborative publications' Average Citations per Item is 15.46. The h-index of all publications (85) reflects the fact that nearly 7000 of these articles do not include statistics. The h-index for the collaborative publications (76) was not significantly reduced. Overall, these results suggest that the collaborative publications have a higher average quality.

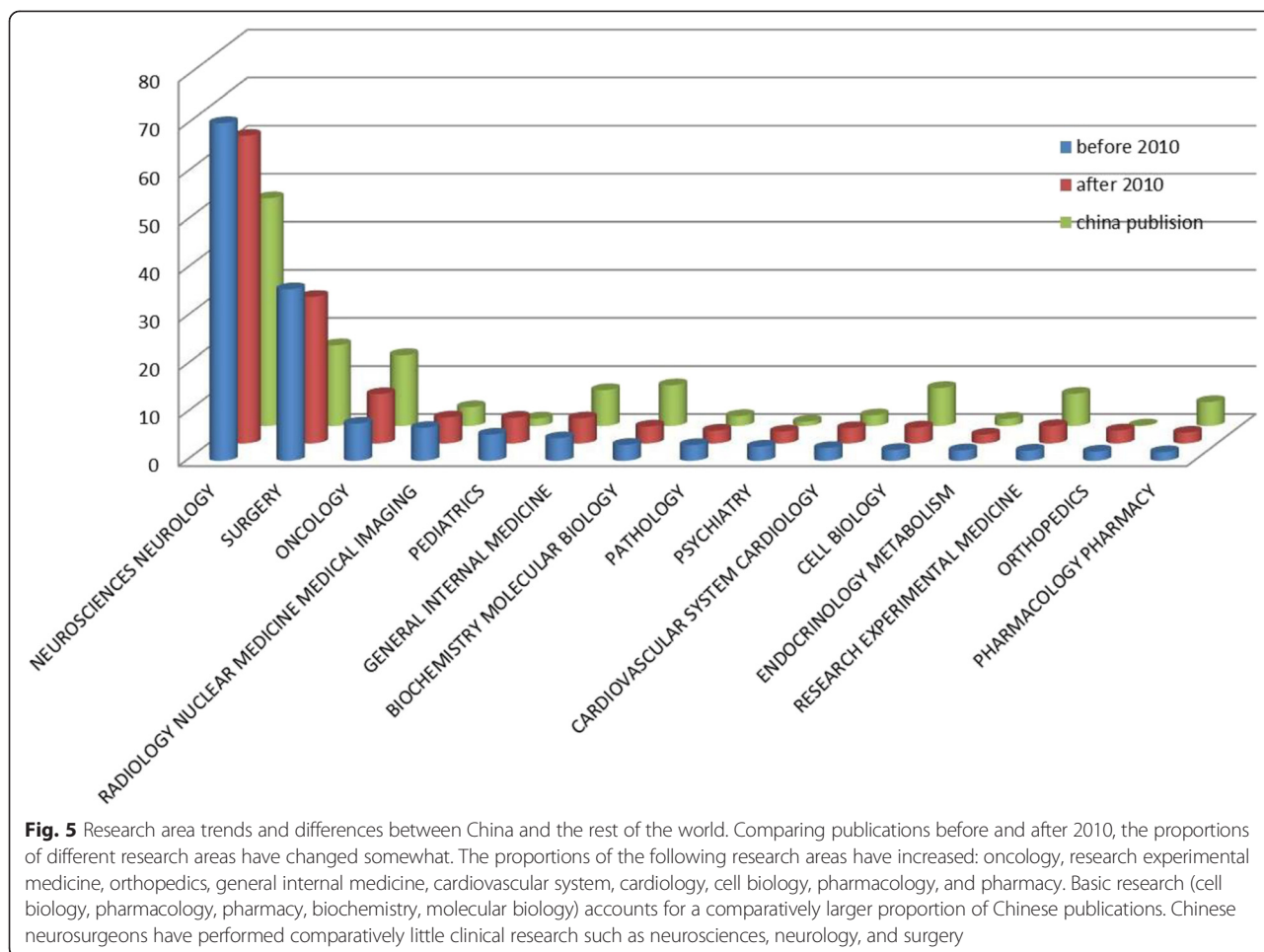
Discussion

For historical reasons, Chinese neurosurgeons have only recently begun to publish their work in English language publications. Compared with foreign neurosurgeons, Chinese neurosurgeons have not historically published prolifically. With China's development, the health care system in China has entered a new era. Chinese physicians need to update their knowledge to remain consistent with global trends, and they also want to share their findings with the world. Publications represent the ideal medium for these communications, and Chinese doctors have recognized this point.

The research output of Chinese neurosurgeons has increased every year, with a growth rate obviously higher than the worldwide average. The proportion of neurosurgical publications with Chinese authors has increased to 13 %, second only after the United States (35 %). Both the quality and quantity of Chinese research has improved, facilitating exchange with neurosurgeons all over the world.

Table 3 Chinese neurosurgical publications cited more than 100

Title	Authors	Source	Cited
1 Glioma-Derived Mutations in IDH1 Dominantly Inhibit IDH1 Catalytic Activity and Induce HIF-1 alpha. [19]	Zhao, Shimin; Lin, Yan; Xu, Wei; Jiang, Wenqing; Zha, Zhengyu; Wang, Pu; Yu, Wei; Li, Zhiqiang; Gong, Lingling; Peng, Yingjie; Ding, Jianping; Lei, Qunying; Guan, Kun-Liang; Xiong, Yue	Science2009, 324:261–5	422
2 Stroke in China: epidemiology, prevention, and management strategies [20]	Liu, Ming; Wu, Bo; Wang, Wen-Zhi; Lee, Li-Ming; Zhang, Shi-Hong; Kong, Ling-Zhi	The Lancet Neurology 2007, 6:456–64.	222
3 hsa-mir-181a and hsa-mir-181b function as tumor suppressors in human glioma cells [21]	Shi, Lei; Cheng, Zihao; Zhang, Junxia; Li, Rui; Zhao, Peng; Fu, Zhen; You, Yonyping	Brain research 2008, 1236:185–93.	200
4 Conversion of human umbilical cord mesenchymal stem cells in Wharton's jelly to dopaminergic neurons in vitro: Potential therapeutic application for parkinsonism [22]	Fu, YS; Cheng, YC; Lin, MYA; Cheng, H; Chu, PM; Chou, SC; Shih, YH; Ko, MH; Sung, MS	Stem cells (Dayton, Ohio) 2006, 24:115–24.	199
5 Improved outcomes from the administration of progesterone for patients with acute severe traumatic brain injury: a randomized controlled trial [23]	Xiao, Guomin; Wei, Jing; Yan, Weiqi; Wang, Weimin; Lu, Zhenhui	Critical care (London, England) 2008, 12:R61	167
6 Astrocyte elevated gene-1 is a novel prognostic marker for breast cancer progression and overall patient survival [24]	Li, Jun; Zhang, Nu; Song, Li-Bing; Liao, Wen-Ting; Jiang, Li-Li; Gong, Li-Yun; Wu, Jueheng; Yuan, Jie; Zhang, Hui-Zhong; Zeng, Mu-Sheng; Li, Mengfeng	Clinical cancer research : 2008, 14:3319–26.	146
7 Monodisperse water-soluble magnetite nanoparticles prepared by polyol process for high-performance magnetic resonance imaging [25]	Wan, Jiaqi; Cai, Wei; Meng, Xiangxi; Liu, Enzhong	Chemical communications (Cambridge, England) 2007:5004–6.	144
8 Early indicators of prognosis in 846 cases of severe traumatic brain injury [26]	Jiang, JY; Gao, GY; Li, WP; Yu, MK; Zhu, C	Journal of neurotrauma 2002, 19:869–74.	128
9 Downregulation of miR-21 inhibits EGFR pathway and suppresses the growth of human glioblastoma cells independent of PTEN status [27]	Zhou, Xuan; Ren, Yu; Moore, Lynette; Mei, Mei; You, Yongping; Xu, Peng; Wang, Baoli; Wang, Guangxiu; Jia, Zhifan; Pu, Peiyu; Zhang, Wei; Kang, Chunsheng	Laboratory investigation; 2010, 90:144–55.	126
10 MicroRNA-128 inhibits glioma cells proliferation by targeting transcription factor E2F3a [28]	Zhang, Yu; Chao, Tengfei; Li, Ran; Liu, Wei; Chen, Yang; Yan, Xingqi; Gong, Yanhua; Yin, Bin; Liu, Wei; Qiang, Boqing; Zhao, Jizhong; Yuan, Jiangang; Peng, Xiaozhong	Journal of molecular medicine (Berlin, Germany) 2009, 87:43–51.	124
11 Detection of multiple gene amplifications in glioblastoma multiforme using array-based comparative genomic hybridization [29]	Hui, ABY; Lo, KW; Yin, XL; Poon, WS; Ng, HK	Laboratory investigation; 2001, 81:717–23.	124
12 Effect of long-term mild hypothermia therapy in patients with severe traumatic brain injury: 1-year follow-up review of 87 cases [30]	Jiang, JY; Yu, MK; Zhu, C	Journal of neurosurgery 2000, 93:546–9.	124
13 Incidence and trends of stroke and its subtypes in China - Results from three large cities [31]	Jiang, B; Wang, WZ; Chen, HL; Hong, Z; Yang, QD; Wu, SP; Du, XL; Bao, QJ	Stroke; 2006, 37:63–8.	117
14 Influence of patients' age on functional recovery after transplantation of olfactory ensheathing cells into injured spinal cord injury [32]	Huang, HY; Chen, L; Wang, HM; Xiu, B; Li, BC; Wang, R; Zhang, J; Zhang, F; Gu, Z; Li, Y; Song, YL; Hao, W; Pang, SY; Sun, JZ	Chinese medical journal 2003, 116:1488–91.	111
15 Surgical management of brain-stem cavernous malformations: Report of 137 cases [33]	Wang, CC; Liu, A; Zhang, JT; Sun, B; Zhao, YL	Surgical neurology 2003, 59:444–54; discussion 454	107
16 Clinical evaluation and follow-up outcome of diffusion tensor imaging-based functional neuronavigation: a prospective, controlled study in patients with gliomas involving pyramidal tracts. [34]	Wu, Jin-Song; Zhou, Liang-Fu; Tang, Wei-Jun; Mao, Ying; Hu, Jin; Song, Yan-Yan; Hong, Xun-Ning; Du, Gu-Hong	Neurosurgery 2007, 61: 935–48; discussion 948-9	106
17 Poly-L-lactic acid/hydroxyapatite hybrid membrane for bone tissue regeneration [35]	Sui, Gang; Yang, Xiaoping; Mei, Fang; Hu, Xiaoyang; Chen, Guoqiang; Deng, Xuliang; Ryu, Seungkon	Journal of biomedical materials research Part A 2007, 82:445–54.	106
18 Overexpression of astrocyte elevated gene-1 (AEG-1) is associated with esophageal squamous cell carcinoma (ESCC) progression and pathogenesis [36]	Yu, Chunping; Chen, Kun; Zheng, Haiqing; Guo, Xianzhi; Jia, Weihua; Li, ManZhi; Zeng, Musheng; Li, Jun; Song, Libing	Carcinogenesis 2009, 30:894–901.	103
19 An in vivo evaluation of a biodegradable genipin-cross-linked gelatin peripheral nerve guide conduit material [37]	Chen, YS; Chang, JY; Cheng, CY; Tsai, FJ; Yao, CH; Liu, BS	Biomaterials 2005, 26:3911–8.	100

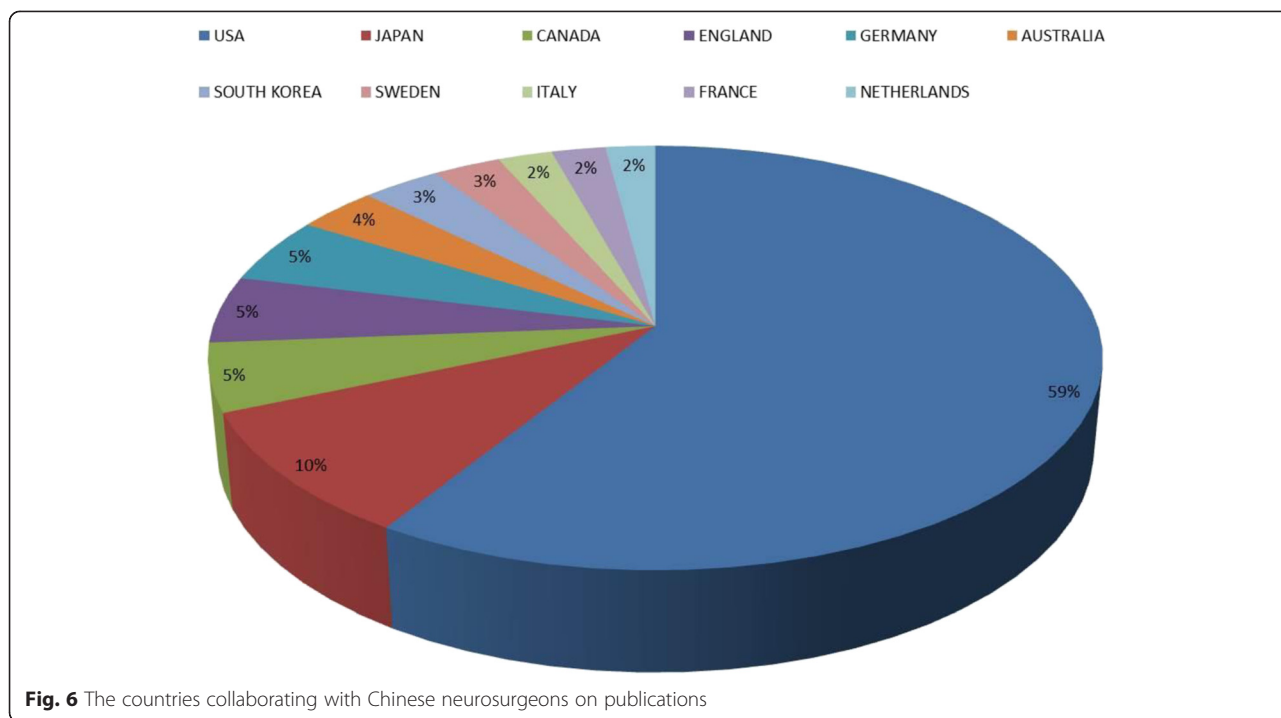


This study highlights the great gap in neurosurgery between China and developed countries. While clinical practice research is an important area of research (neurosciences, neurology, and surgery) for neurosurgeons throughout the world, this research area represents a weak point for Chinese neurosurgeons. In real clinical work, Chinese neurosurgeons also follow guidelines from developed countries. Each country's clinical practice has its own features, and issues with the implementation of clinical practice guidelines must be taken into account [11, 12]. Chinese neurosurgeons should develop guidelines in line with their evidence combined with their social and cultural environment [13]. This calls for increased attention to clinical research in the future.

China presents several advantages for clinical research. China has the largest population base, the largest pool of disease cases, and the largest group of neurosurgeons. Chinese clinical research results should be credible and widespread because of the large number of Chinese neurosurgeons. Meanwhile, we should maintain our strength in basic research, as these research results can be translated into clinical practice.

Chinese authors have infrequently published in the classic neurosurgical journals such as "Journal of Neurosurgery" and "Neurosurgery". To solve this problem, Chinese neurosurgeons need to target these journals with the aim of allowing more foreign counterparts to understand what Chinese doctors have done. Although there are a few neurosurgical journals in China, they are all published in Chinese and can only be read by Chinese readers. A direct way to expand the influence of Chinese neurosurgery is to build China's own neurosurgical publication platform. "Chinese Neurosurgical Journal" is the first Neurosurgical journal published in English in China. There is no doubt that "Chinese Neurosurgical Journal" will play an important role in introducing Chinese studies to the world.

Capital Medical University and Fudan University are the leading Chinese organizations in this field, mainly because these two universities have very well-known neurosurgical centers, such as the neurosurgical departments in Tiantan Hospital [14] and Huashan Hospital [15]. Beijing Neurosurgical Institute (number 3 in the list) is also set in Beijing Tiantan Hospital and



has many links with Beijing Tiantan Hospital. The list of organizations shows that most of the organizations are in central cities of eastern China, reflecting China's vast territory and unbalanced development.

China presents several advantages for clinical research. China has the largest population base, the largest pool of disease cases, and the largest group of neurosurgeons. Chinese clinical research results should be credible and widespread because of the large number of Chinese neurosurgeons.

Neurosurgeons play an unparalleled role in the development of brain research. Neurosurgery is a rapidly developing field of research, and now that Chinese neurosurgeons have begun to play a major role in this field, they should seize the opportunity and continue to publish important basic and clinical research in top journals in the field.

Table 4 Citation report of all China neurosurgeon's publications and cooperation publications

	All Chinese publications	Cooperation publications
Results found:	9385	2393
Sum of the Times Cited	77275	37000
Citing Articles	59272	35745
Citing Articles without self-citations	55306	31949
Average Citations per Item	8.23	15.46
h-index	85	76

Limitations of this study

While the Web of Science is an excellent database, it has several limitations. Web of Science is an English-language database, containing very little literature in other languages. This may lead to a selection bias.

Another limitation comes from scientometrics and bibliometrics. The statement that "no one metric can fully capture the complex contributions scholars make to their disciplines"[16] highlights the deficiencies of the journal impact factor (JIF) [17]. There is a growing view that for greater accuracy, the JIF must be supplemented with an article-based assessment and peer-review [18]. Therefore, this study valued article-based citations rather than the journal impact factor.

Conclusion

While Chinese neurosurgical publication has made great progress, there is still significant room for improvement. The next step is to strengthen Chinese neurosurgical clinical studies and to improve the publishing environment of Chinese neurosurgeons in an effort to introduce the results to the rest of the world.

Competing interests

All authors declare that they have no competing interests (both financial and non-financial competing interests).

Authors' contributions

Weiming Liu designed and supervised the entire study. Deling Li and Weiqing Wan searched the database. Wang Jia and Jie Tang extracted data and reported results. Ming Ni and Guijun Jia reviewed the report and

provided recommendations on the discussion and conclusion. All authors read and approved the final manuscript.

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