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Acupuncture in stroke rehabilitation

Literature retrieval based on international databases[★]

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Abstract

OBJECTIVE: To identify global research trends of acupuncture in stroke rehabilitation using a bibliometric analysis of the Web of Science and the Clinical Trials registry database (ClinicalTrials.gov).

DATA RETRIEVAL: We performed a bibliometric analysis of data retrievals for acupuncture in stroke rehabilitation from 1992 to 2011 using the Web of Science and ClinicalTrials.gov.

SELECTION CRITERIA: Inclusion criteria: (1) Web of Science: (a) Peer-reviewed articles on acupuncture in stroke rehabilitation that were published and indexed in the Web of Science. (b) Type of articles: original research articles, reviews, meeting abstracts, proceedings papers, book chapters, editorial material and news items. (c) Year of publication: 1992–2011. (2) ClinicalTrials.gov: All clinical trials relating to acupuncture in stroke rehabilitation were searched in this database. Exclusion criteria: (1) Web of Science: (a) Articles that required manual searching or telephone access. (b) We excluded documents that were not published in the public domain. (c) We excluded a number of corrected papers from the total number of articles. (2) ClinicalTrials.gov: (a) We excluded clinical trials that were not in the ClinicalTrials.gov database. (b) We excluded clinical trials that dealt with magnetic stimulation other than acupuncture in stroke rehabilitation in the ClinicalTrials.gov database.

MAIN OUTCOME MEASURES: (1) Type of literature; (2) annual publication output; (3) distribution according to journals; (4) distribution according to country; (5) distribution according to institution; (6) top cited articles over the last 20 years; and (7) clinical trials registered.

RESULTS: (1) In all, 92 studies on acupuncture in stroke rehabilitation appeared in the Web of Science from 1992 to 2011, almost half of which derived from Chinese and American authors and institutes. The number of studies addressing acupuncture in stroke rehabilitation has gradually increased over the past 20 years. Most papers on acupuncture in stroke rehabilitation appeared in journals with a particular focus on rehabilitation research, such as *Stroke*, *Archives of Physical Medicine*, *Cochrane Database of Systematic Reviews* and *Journal of Alternative and Complementary Medicine*. (2) In the ClinicalTrials.gov, three studies can be searched on acupuncture and stroke, all of which were registered and sponsored by Chinese institutions since February 2009.

CONCLUSION: From our analysis of the literature and research trends, we found that acupuncture in stroke rehabilitation may offer further benefits in regenerative medicine.

Key Words

acupuncture; stroke; rehabilitation; Web of Science; Clinical Trials; bibliometric; neural regeneration

Abbreviations

ClinicalTrials.gov, Clinical Trials registry database

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INTRODUCTION

Stroke is defined by the World Health Organization as a clinical syndrome characterized by rapidly developing signs of focal or global disturbance of cerebral functions, lasting for more than 24 hours or leading to death, with no apparent causes other than vascular origin^[1]. Stroke brings great threat to human life for its high attack rate, high mortality, as well as disability rate, which leads to heavy burden to patient's family and society^[2].

Acupuncture can bring multiple biological responses for human body, including circulatory and biochemical effects. These responses can occur locally or close to the site of application, or at a distance. They are mediated mainly by sensory neurons to many structures within the central nervous system. This can lead to activation of pathways in the brain as well as in the periphery, which affecting various physiological systems^[3-5].

Acupuncture is claimed to be effective for a wide range of conditions, such as pain, musculoskeletal disorders and several neurologic diseases^[6]. It has been well accepted by Chinese patients and is used as an adjunct treatment to improve motor, sensation, speech, and other neurological functions in patients with stroke since ancient China^[7].

Although acupuncture is not generally accepted in western countries due to lack of convincing evidence of efficacy, it is also increasingly applied in stroke patients^[8-9]. Positive results have been reported in studies with different designs and treatments from 24 hours to 8 years after stroke onset^[10-14]. Few studies have been randomized, and the use of control or sham groups is varied. In its Conclusions and Recommendations section, the panel of the National Institutes of Health (NIH) Consensus Development Conference on Acupuncture recently stated that "there are other situations such as...stroke rehabilitation...where acupuncture may be useful as an adjunct treatment or an acceptable alternative or be included in a comprehensive management program"^[15]. Experimental studies have demonstrated that acupuncture has effects in common with physical exercise on the release of transmitters and peptides in brain and spinal cord^[16-18].

In this study, we performed a bibliometric analysis based on the Web of Science (published by the Institute for Scientific Information) to identify the broad patterns in global research and improve the assessment of research trends in research of acupuncture in stroke rehabilitation over the past 20 years and the Clinical Trials registry database (ClinicalTrials.gov) was also searched to find items on acupuncture and stroke.

RESULTS

The types of publication relating to acupuncture in stroke rehabilitation that were included in the Web of Science from 1992 to 2011 (Table 1)

Table 1 Types of publication on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Type of literature	No. of papers	% of total publication
Article	58	63.04
Review	14	15.22
Letter	8	8.70
Proceedings paper	6	6.52
Editorial material	5	5.44
Correction	1	1.09
Meeting abstract	1	1.09
News item	1	1.09

From Table 1, it is evident that articles, reviews, and meeting abstracts constituted the major types of publication relating to acupuncture in stroke rehabilitation over this period. There were 58 articles, accounting for 63.04% of the total number of publications, which was more than any other type of literature; these were followed by reviews (14), which accounted for 15.22%.

The annual publication output on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011 (Figure 1)

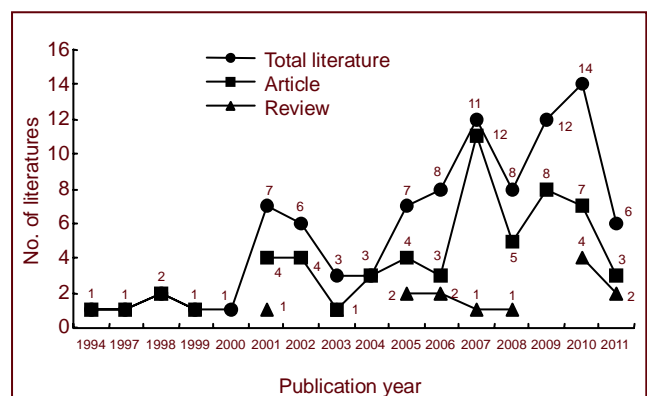


Figure 1 Annual number of publications on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011.

There were 92 publications on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011. The number of publications on acupuncture in stroke rehabilitation has gradually increased over the past 20 years. In all, 14 papers were published and included in the Web of Science in 2010, which was much more than

in 1994. However, there was a decrease in the number of papers published in 2003 and 2004. The journals that published acupuncture in stroke rehabilitation and were included in the Web of Science from 1992 to 2011 are presented in Table 2.

Table 2 Top 15 journals that published studies on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Journal	No. of papers	% of total publication
Stroke	17	18.48
Archives of Physical Medicine and Rehabilitation	8	8.70
Cochrane Database of Systematic Reviews	5	5.44
Journal of Alternative and Complementary Medicine	5	5.44
Clinical Rehabilitation	3	3.26
Journal of Rehabilitation Medicine	3	3.26
Neural Regeneration Research	3	3.26
American Journal of Chinese Medicine	2	2.17
American Journal of Physical Medicine Rehabilitation	2	2.17
Archives of Internal Medicine	2	2.17
Canadian Medical Association Journal	2	2.17
International Journal of Neuroscience	2	2.17
Journal of Neurology	2	2.17
Neurological Research	2	2.17
Topics in Stroke Rehabilitation	2	2.17

From Table 2, it is evident that most of the papers on acupuncture in stroke rehabilitation appeared in journals with a particular focus on rehabilitation research. *Stroke* published 17 papers, which accounted for 18.48% of the total number of publications; this was followed by the *Archives of Physical Medicine*, which published 8 papers and accounted for 8.70%. *Cochrane Database of Systematic Reviews* and *Journal of Alternative and Complementary Medicine* both published 5 papers. Information relating to the top three journals appears in Table 3.

The distribution of subject areas related to acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011 (Table 4)

From Table 4, it is evident that among the subject categories related to acupuncture in stroke rehabilitation, the greatest number of studies (27 papers) was in the

field of rehabilitation, which accounted for 29.35%. With 25 papers, the second-highest number of studies was in the field of clinical neurology, which accounted for 27.17%.

Table 3 Details of the top four journals on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Journal	ISSN	Impact factor	Issues per year	Citable Items
Stroke	0039-2499	5.756	12	532
Archives of Physical Medicine and Rehabilitation	0003-9993	2.254	12	283
Cochrane Database of Systematic Reviews	1469-493X	6.186	NA	749
Journal of Alternative and Complementary Medicine	1075-5535	1.498	12	162

Journal	Publisher	Country/Territory	Number of papers from Chinese in 2011
Stroke	LIPPINCOTT WILLIAMS & WILKINS	USA	52
Archives of Physical Medicine and Rehabilitation	W B SAUNDERS CO-ELSEVIER INC	USA	13
Cochrane Database of Systematic Reviews	WILEY-BLACKWELL	UK	52
Journal of Alternative and Complementary Medicine	MARY ANN LIEBERT INC	USA	19

Table 4 Distribution of subject areas related to acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Subject area	No. of papers	% of total publication
Rehabilitation	27	29.35
Clinical neurology	25	27.17
Peripheral vascular disease	17	18.48
Medicine general internal	15	16.30
Sport sciences	14	15.22
Integrative complementary medicine	12	13.04
Neurosciences	11	11.96

The country distribution of publications on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011 (Table 5)

Table 5 Top 10 countries in terms of number of studies on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Country	No. of papers	% of total publication
China	30	32.61
USA	27	29.35
UK	12	13.04
South Korea	11	11.96
Taiwan	8	8.70
Canada	6	6.52
Sweden	6	6.52
Germany	4	4.35
Austria	3	3.26
Singapore	3	3.26

From Table 5, it is clear that the China published the most number of papers on acupuncture in stroke rehabilitation; it published 30 papers, which accounted for 32.61% of the total. United States ranked second with 24 papers and accounted for 29.35%.

The most institutions from China included in the Web of Science from 1992 to 2011 (Table 6)

Table 6 The most institutions from China on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Institution	No. of papers	% of total publication
Sichuan University	4	13.33
Chinese University of Hong Kong	3	10.00
Hong Kong Polytechnic University	3	10.00
Capital University of Medical Sciences	2	6.67
Chang Gung Memorial Hospital	2	6.67
China Medical University	2	6.67
National Cheng Kung University	2	6.67
Sha Tin Hospital	2	6.67
Sun Yat-sen University	2	6.67
Tianjin University of Traditional Chinese Medicine	2	6.67
University of Hong Kong	2	6.67

The most cited publications from China included in the Web of Science from 1992 to 2011 (Table 7)

Table 7 The most cited publications from China on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Title	Total citation	Publication year
Clinical trial of electrical acupuncture on hemiplegic stroke patients ^[19]	1999	61
Does acupuncture improve motor recovery after stroke? A meta-analysis of randomized controlled trials ^[20]	2002	36
Does acupuncture have additional value to standard poststroke motor rehabilitation? ^[21]	2002	30
Clinical trial of acupuncture for patients with spinal cord injuries ^[22]	2003	20
Acupuncture for acute stroke- art. no. CD003317.pub2 ^[23]	2005	17
An fMRI study of somatosensory-implicated acupuncture points in stable somatosensory stroke patients ^[24]	2006	11
Additional therapeutic effects of electroacupuncture in conjunction with conventional rehabilitation for patients with first-ever ischaemic stroke ^[25]	2007	10
Acupuncture for stroke rehabilitation ^[26]	2006	9
Acupuncture increases cerebral glucose metabolism in human vascular dementia ^[27]	2007	9

The number of publications on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011 (Table 8)

Table 8 Top 12 institutions publishing studies on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011

Institution	No. of papers	% of total publication
Harvard University	6	6.52
Korea Institute of Oriental Medicine	6	6.52
Exeter University	6	6.52
Kyung Hee University	5	5.44
New England School of Acupuncture	4	4.35
Sichuan University	4	4.35
Chinese University of Hong Kong	3	3.26
Hong Kong Polytechnic University	3	3.26
Massachusetts General Hospital	3	3.26
Pusan National University	3	3.26
Lund University Hospital	3	3.26
Plymouth University	3	3.26

In Table 8, it is evident that the top institution for studies on acupuncture in stroke rehabilitation is the Harvard University, the Korea Institute of Oriental Medicine and Exeter University, followed by Kyung Hee University.

The most cited papers of Harvard University related to acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Acupuncture for subacute stroke rehabilitation-A sham-controlled, subject- and assessor-blind, randomized trial, wrote by Park *et al*^[28], and published on Archives of Internal Medicine in 2005, with 21 citations.

Acupuncture for upper-extremity rehabilitation in chronic stroke: A randomized sham-controlled study, wrote by Wayne *et al*^[29], and published on Archives of Physical Medicine and Rehabilitation in 2005, with 20 citations.

Clinical characteristics and rehabilitation outcomes of patients with posterior cerebral artery stroke, wrote by Ng *et al*^[30], and published on Archives of Physical Medicine and Rehabilitation in 2005, with 11 citations.

The most cited papers of Korea Institute of Oriental Medicine relating to acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011

Acupuncture application for neurological disorders, wrote by Lee *et al*^[31], and published on Neurological Research in 2007, with 18 citations.

Moxibustion for Stroke Rehabilitation Systematic Review, wrote by Lee *et al*^[32], and published on Stroke in 2010, with five citations.

Acupuncture for functional recovery after stroke: a systematic review of sham-controlled randomized clinical trials, wrote by Kong *et al*^[33], and published on Canadian Medical Association Journal in 2010, with four citations.

The most cited review papers on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011

Effectiveness of acupuncture for stroke: A systematic review, wrote by Park *et al*^[34], and published on Journal of Neurology in 2001, with 39 citations.

Acupuncture in clinical neurology, wrote by Rabinstein *et al*^[35], and published on Neurologist in 2003, with 22 citations.

Treatment of urinary incontinence after stroke in adults, wrote by Thomas *et al*^[36], and published on Cochrane Database of Systematic Reviews in 2008, with 16 citations.

Acupuncture in poststroke rehabilitation a systematic review and meta-analysis of randomized trials, wrote by Wu *et al*^[37], and published on Stroke in 2010, with 9

citations.

The most cited articles on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011 (Table 9)

Table 9 Most cited articles on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011

Title	Source title	Publication year	Total citation
Clinical trial of electrical acupuncture on hemiplegic stroke patients ^[19]	American Journal of Physical Medicine & Rehabilitation	1999	61
Acupuncture and transcutaneous nerve stimulation in stroke rehabilitation-A randomized, controlled trial ^[38]	Stroke	2001	59
Sensory stimulation promotes normalization of postural control after stroke ^[39]	Stroke	1994	51
Effects of acupuncture treatment on daily life activities and quality of life - A controlled, prospective, and randomized study of acute stroke patients ^[40]	Stroke	1998	45
Does acupuncture improve motor recovery after stroke? A meta-analysis of randomized controlled trials ^[20]	Stroke	2002	36
A one year follow-up study on the effects of acupuncture in the treatment of stroke patients in the subacute stage: a randomized, controlled study ^[41]	Clinical Rehabilitation	1997	31
Long-term effects of 6-week whole-body vibration on balance recovery and activities of daily living in the postacute phase of stroke-A randomized, controlled trial ^[42]	Stroke	2006	31
Does acupuncture have additional value to standard poststroke motor rehabilitation? ^[21]	Stroke	2002	30
Acupuncture for subacute stroke rehabilitation-A sham-controlled, subject- and assessor-blind, randomized trial ^[28]	Archives of Internal Medicine	2005	21
Transcutaneous electrical nerve stimulation combined with task-related training improves lower limb functions in subjects with chronic stroke ^[43]	Stroke	2007	21

Clinical Trials registry database (ClinicalTrials.gov), developed by the Food and Drug Administration of the NIH, offers up-to-date information on locating federally and privately supported clinical trials for a wide range of diseases and conditions. A clinical trial (also known as clinical research) is a research study using human volunteers to answer specific health questions. ClinicalTrials.gov currently contains 124 717 trials sponsored by the NIH, other federal agencies, and private industry. The studies listed in its database are conducted in all 50 states and in 179 countries. ClinicalTrials.gov receives over 50 million page views per month and 65 000 visitors daily.

The clinical trial on acupuncture on stroke including “Can acupuncture benefit surgical patients with haemorrhagic stroke?” Phase 1, which is registered and sponsored by Chinese University of Hong Kong and led by George KC Wong; it began in December 2009. The aim of this study is to study whether acupuncture in addition to conventional rehabilitation programme can improve the functional outcome and quality of life of surgical patients with haemorrhagic stroke, as compared to conventional rehabilitation programme alone.

“Efficiency study of traditional Chinese medicine versus Western medicine on ischemic stroke”, which is registered and sponsored by China Academy of Chinese Medical Sciences and led by Yanming Xie; it began in February 2009. The aim of this study is to study the efficiency of traditional Chinese medicine on early rehabilitation and secondary prevention of ischemic stroke is same or better than that of Western medicine.

“Establishment and evaluation to the effects of a clinical pathway for acute ischemic stroke” Phase 4, which is registered and sponsored by Guangzhou University of Traditional Chinese Medicine and led by Yefeng Cai; it began in December 2009. The aim of this study is to determine whether the clinical pathway for acute ischemic stroke (with combination of traditional Chinese medicine and western medicine) is able to improve the outcome of acute ischemic stroke and evaluate its effect on hospital day and cost, etc. Meanwhile, the study will discuss the safety and efficiency of this kind of clinical pathway.

DISCUSSION

Based on our bibliometric results with the Web of Science, we found the following research trends in studies on acupuncture in stroke rehabilitation over the past 20 years. In all, 92 publications on acupuncture in stroke rehabilitation studies were retrieved from the Web of Science from 1992 to 2011, of which almost half the publications derived from Chinese and American authors and institutes. The number of publications on

acupuncture in stroke rehabilitation has gradually increased over the past 20 years. Most papers on acupuncture in stroke rehabilitation appeared in journals with a focus on rehabilitation research, such as *Stroke*, *Archives of Physical Medicine*, *Cochrane Database of Systematic Reviews* and *Journal of Alternative and Complementary Medicine*.

In the ClinicalTrials.gov, there are three registered trials—“Can acupuncture benefit surgical patients with haemorrhagic stroke?”; “Efficiency study of traditional Chinese medicine versus Western medicine on ischemic stroke” and “Establishment and evaluation to the effects of a clinical pathway for acute ischemic stroke”. All the three studies are sponsored by Chinese institutions since February 2009.

Much attention and effort has been devoted to stroke treatment and rehabilitation using acupuncture. The findings of the present study may be of interest to fellow researchers who are currently undertaking studies on acupuncture in stroke rehabilitation or those who may do so in the future.

DATA SOURCES AND METHODOLOGY

Design

A bibliometric study.

Time and setting

We carried out this bibliometric study at Fifth People's Hospital of Shenyang in February 2012.

Data retrieval

In this study, we used bibliometric methods to quantitatively and qualitatively investigate research trends in studies of acupuncture in stroke rehabilitation. For this purpose, we employed the Web of Science, a research database of publications and citations that is selected and evaluated by the Institute for Scientific Information in Philadelphia, PA, USA.

For bibliometric analyses, we searched the Web of Science using the key words stroke or “cerebral infarct”, “cerebrovascular disease”, “cerebral ischemia”, “rehabilitation” and “acupuncture”. We limited the period of publication from 1992 to 2011 in compiling a bibliography of all articles related to acupuncture in stroke rehabilitation. We searched 92 results, and we downloaded the data on February 20, 2012.

Inclusion criteria

The inclusion criteria are as follows. (1) Peer-reviewed articles on acupuncture in stroke rehabilitation that were published and indexed in the Web of Science, including original research articles, reviews, meeting abstracts, proceedings papers, book chapters, editorial material,

and news items. The year of publication was 1992–2011 (inclusive). The citation databases are as follows: Science Citation Index-Expanded (SCI-E), 1899-present; Conference Proceedings Citation Index-Science (CPCI-S) 1991–present; Book Citation Index-Science (BKCI-S), 2005–present. (2) Clinical trials on acupuncture in stroke rehabilitation were included.

Exclusion criteria

(1) Web of Science: We excluded articles that required manually searching or telephone access. We excluded documents that were not published in the public domain. We excluded a number of corrected papers from the total number of articles analyzed.

(2) ClinicalTrials.gov: We excluded clinical trials that were not registered on the ClinicalTrials.gov database. We also excluded clinical trials in ClinicalTrials.gov that dealt with magnetic stimulation other than acupuncture in stroke rehabilitation.

Data evaluation

The outcomes of all articles referring to acupuncture in stroke rehabilitation were measured using the following criteria: (a) type of literature on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011; (b) annual publication output on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011; (c) journal publications on acupuncture in stroke rehabilitation included in the Web of Science from 1992 to 2011; (d) distribution of publications on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011 by subject area; (e) publications on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011 according to country; (f) publications on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011 by institution; (g) the most cited papers on acupuncture in stroke rehabilitation in the Web of Science from 1992 to 2011; (h) trials on acupuncture in stroke rehabilitation in ClinicalTrials.gov on.

Author contributions: Feng Sun retrieved the references, extracted the data, conceived and designed the study, and wrote the manuscript. Jinchun Wang retrieved the references, extracted the data, and conceived and designed the study. Xia Wen contributed to the review, conception and design, paper revision, and study instruction.

Conflicts of interest: None declared.

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