

A Bibliometric Analysis of Acupuncture Treatment of Postoperative Complications from 2003 to 2023

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Background: Postoperative complications refer to some related clinical symptoms that occur after surgery, which can affect the patient's recovery. Acupuncture has a good effects on postoperative complications, which can accelerate postoperative recovery. Currently, there are many literature studies in this field. However, there has been no quantitative analysis of these literature. Therefore, in this study, the bibliometric method was adopted to analyze the relevant literature, thereby exploring the research hotspots and trends in this field.

Methods: Through the web of science core database, we collected the relevant literature on the acupuncture treatment of postoperative complications from 2003 to 2023, used citespace software to analyze the author, publishing institution, country, keywords, references, cited journals and other information of these literature, and analyzed its research hotspots and research trends through a visual view.

Results: A total of 213 articles were obtained, and the annual publication volume overall is on the rise, especially in recent years when the publication volume has surged. The field with the highest number of publications is Integrative Complementary Medicine. The most cited journal is Evidence-Based Complementary and Alternative Medicine. The country with the highest number of publications is China, and the institution with the highest number of publications is Capital Medical University. The author with the highest number of publications is Zhu, Junchao. The most central cited author is LEE A. The articles with the highest frequency and centrality of cited references are published by Liu, Y. H. The most frequently studied keywords are acupuncture.

Conclusion: This study systematically analyzes the current research status and hotspots of acupuncture treatment for postoperative complications in the past 20 years, which can help researchers grasp the current research direction and provide reference basis for further research.

Keywords: acupuncture, postoperative complications, bibliometric analysis, research trends

Introduction

Postoperative complications (PC) often refer to any deviation from the ideal postoperative process,^{1,2} which can significantly increase the mortality rate, length of hospital stay, and medical expenses of surgical patients, resulting in a huge medical burden.³ Surgery, as an important tool for treating and preventing diseases, plays a crucial role in improving people's quality of life and promoting economic development, and is an indispensable part of medical assistance.⁴ However, while surgery treats diseases, it also produces some postoperative complications,⁵ such as postoperative pain, gastrointestinal dysfunction, cognitive impairment, and infections.⁶ PC can cause stress reactions in the body, including local reactions, organ changes, systemic reactions, etc. Excessive stress reactions can cause a certain degree of damage to the internal environment of the machine, weaken physiological reserves, and lead to changes in the body's nerves, endocrine system, circulation, respiration, digestion, urogenital system, blood, immunity, metabolism, and other aspects, leading to serious consequences such as postoperative infections, tumors, and immune deficiency.⁷

A prospective cohort study involving 44814 patients from 474 hospitals in 27 countries showed that 7508 (16.8%) patients experienced one or more complications and 207 (0.5%) died. The total mortality rate of patients with complications is 2.8%, and the mortality rate of patients with various complications varies from 2.4% for pulmonary embolism to 43.9% for cardiac arrest.⁸ In summary, up to 20–30% of patients will experience PC, with short-term mortality ranging from 1% to 4%, and the occurrence of complications will significantly increase patient mortality. More seriously, PC may be higher in certain special populations, such as elderly patients and emergency patients.^{9,10} In addition to increasing mortality, complications themselves can also cause other secondary complications,^{11,12} increase the probability of readmission,¹³ extend hospital stay,¹⁴ increase the use of medical resources, including critical care, and reduce patient quality of life.¹⁵ In addition, in terms of medical expenses, the incidence of complications in patients undergoing the same surgery can reach more than 5 times that of those who did not.¹⁶ PC will undoubtedly bring a huge clinical and economic burden to healthcare.³

Acupuncture can regulate excessive stress response, regulate various functions such as nerves, endocrine system, circulation, respiration, digestion, immunity, metabolism, etc. and maintain a stable state of the body. While promoting postoperative recovery, it can effectively reduce the occurrence of postoperative complications,¹⁷ such as reducing postoperative pain,^{18–20} preventing postoperative nausea and vomiting,^{21–23} preventing postoperative cognitive impairment,²⁴ promoting the recovery of gastrointestinal and bladder functions,^{25–27} and reducing postoperative itching.²⁸ Promoting the recovery of postoperative immune function can further promote the recovery of postoperative body function and improve the long-term prognosis of patients.^{29–31}

Bibliometrics is a discipline that studies literature or literature related media, using mathematical, statistical, and other econometric methods to conduct quantitative statistics on the publication time, country, research direction, publishing institutions, and journals of literature, studying the quantitative relationship and laws between literature and literature work systems, and exploring the dynamic characteristics of science and technology.^{32,33} It is a comprehensive knowledge system that integrates mathematics, statistics, and literature studies, emphasizing quantification. Especially the application of information visualization technology means and methods can intuitively and quickly understand the evolution process of cutting-edge issues in the discipline or knowledge field, obtain the current research status, research hotspots, latest progress and development trends in this field, and help scholars have a macro grasp of relevant research.^{34–36}

CiteSpace software, developed by Professor Chen Chaomei from Drexel University, has visual analysis capabilities and is one of the most commonly used bibliometric analysis software.^{37–40} It can conduct big data econometric analysis on literature in your research field, which can intuitively help you clarify the evolution of the field; Identify key literature, journals, authors, institutions, etc. in the field; Help you explore the research frontiers and development trends in this field, and provide reference for future research.^{41–43}

At present, a large number of clinical studies show that acupuncture has been widely used in postoperative surgery and in the intervention of complications,^{44–48} which plays a very good role in accelerating the construction of rehabilitation surgery.^{49,50} However, as far as we know, there is no bibliometric analysis based on Citespace's acupuncture treatment of PC. Therefore, the purpose of this study is to conduct a macro review of the literature from 2003 to 2023 through Citespace, evaluate the effect of acupuncture therapy on PC, research hotspots and research trends, and hope to better help accelerate the construction of rehabilitation surgery.

Methods

Source of Literature

In order to ensure the comprehensiveness of literature retrieval and avoid omissions, we obtained the synonyms for “postoperative complications” and “acupuncture therapy” through the MeSH Database in PubMed, we find the Entry Terms of “postoperative complications” include “Complication, Postoperative”, “Complications, Postoperative”, “Postoperative Complication”, the Entry Terms of “acupuncture therapy” include “Acupotomy”, “Acupotomies”, “Acupuncture Treatment”, “Therapy, Acupuncture”, “Treatment, Acupuncture”, “Acupuncture Treatments”, “Pharmacoacupuncture Therapy”, “Therapy, Pharmacoacupuncture”, “Pharmacoacupuncture Treatment”, “Treatment, Pharmacoacupuncture” and some other synonyms that we found from other articles.^{51,52} We put it together to searching,

All data collection was performed on October 26, 2023, searching the WOSCC for all literature published ranged from October 1, 2003, to September 30, 2023. The search was not limited to the language, category or document type. Two authors independently searched the references. Any differences were resolved by Wei Xu and Wenguo Ye, and a total of 213 references were identified, as shown in Table 1. The searched scientific network database is from the library database of Jiangxi University of Chinese Medicine, China.

Analysis Tool

This study used Citespace software, version 6.2.R4 (64 bit) Advanced, invented by Professor Chen Chaomei from the Department of Computer and Information Science at Drexel University.³⁹

Citespace parameters are as follows: Time slice, 2003–2023; The number of years per slice (1); Source terms, all options; Node selection type, one at a time; Trim, Pathfinder. The visual knowledge graph is mainly composed of nodes and links. Different nodes represent different elements, such as institution, country, author and keyword. Each node has a different color from the inside out to represent a different year (2003–2023). The connecting lines between each node represent simultaneous references. The purple circle represents centrality, and the darker the purple, the higher the centrality, the more important it is.^{53,54}

Results and Discussion

Analysis of Publication Outputs

The annual publication volume is an important evaluation indicator for scientific research, which to some extent reflects the growth of knowledge in the field. The number of papers published annually on acupuncture treatment of PC from 2003 to 2023, as shown in Figure 1. $y=1.2835x-2.8263$ $R^2=0.7766$, We can see that it has a clear growth trend. It is mainly divided into three stages. In the first stage, from 2003 to 2012, there was no significant increase in the annual publication volume, from 3 articles per year to 6 articles per year. This indicates that there was less research in this field during this period and the attention to this field was not high. In the second stage, from 2012 to 2016, the number of publications in this field increased and decreased, with significant fluctuations, indicating that research during this period is still immature. In the third stage, from 2016 to 2023, the annual publication volume showed a blowout growth, especially from 2021 to 2022, where the publication volume increased from 20 to 34, indicating an increase in researchers' attention to this field during this period, which is a research hotspot. Although the number of articles published so far in 2023 is only 25, considering that 2023 is not yet over, it is believed that there will be some increase in the future. Because the research on acupuncture treatment of PC has been increasing in recent years, and acupuncture has also played a great role in accelerating the construction of enhanced recovery after surgery.

Table 1 Search Queries

Set	Results	Search Query
#1	152334	TS= (Postoperative complications or Complication, Postoperative or Complications, Postoperative or Postoperative Complication or Postoperative Complications or Postoperative Complication)
#2	24527	TS= (Acupuncture Therapy OR Acupuncture Treatment OR Acupuncture Treatments OR Treatment, Acupuncture OR Therapy, Acupuncture OR Pharmacopuncture Treatment OR Treatment, Pharmacopuncture OR Pharmacopuncture Therapy OR Therapy, Pharmacopuncture OR autotomy OR anulotomies OR Acupuncture OR Electroacupuncture OR electro-acupuncture OR Acupuncture and moxibustion OR Needle knife OR body Acupuncture OR Needle Acupuncture OR Manual Acupuncture OR Acupuncture point OR Electro-acupuncture OR warm Acupuncture OR Auricular Acupuncture OR Ear Acupuncture OR Moxibustion OR moxibustion OR acupoint injection OR catgut embedding OR catgut implantation at acupoint OR embedding thread OR moxibustion acupuncture OR fire needling OR fire needle OR fire acupuncture OR Scalp Acupuncture OR Scalp Acupuncture OR Skin Acupuncture)
#3	213	#1 AND #2

Note: # 1 represents step 1.

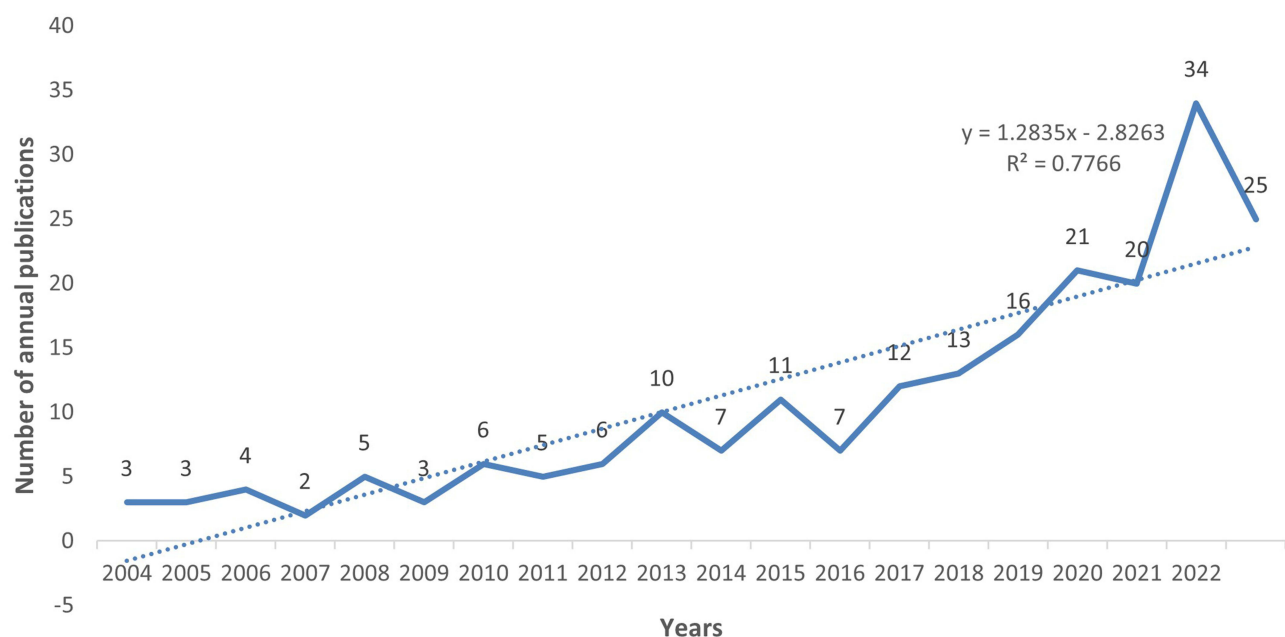


Figure 1 The annual number of publications on acupuncture for PC from 2003 to 2023.

Analysis of Journals and Cited Journals

This study searched a total of 213 articles, mainly consisting of 6 document types, with articles (155) and reviews (53) accounting for the majority. The specific quantity and proportion of each part are shown in Figure 2. In the field of acupuncture treatment of PC, the most published papers are in the field of Integrative Complementary Medicine, with 40 papers. This shows that acupuncture in the treatment of PC, although there are a lot of papers published, but still plays a complementary role in alternative medicine, followed by Medicine General Internal and surgery, with 39 papers. The top 10 journal categories, as shown in Table 2, cover virtually every field of medicine, this shows that acupuncture is more and more widely used as a complementary and alternative medicine, and has been paid attention to by various disciplines.

A cited journal refers to the journal's articles being cited by other articles, which can reflect the academic influence and popularity of the journal. We all know which papers and journals with more citations indicate that their research

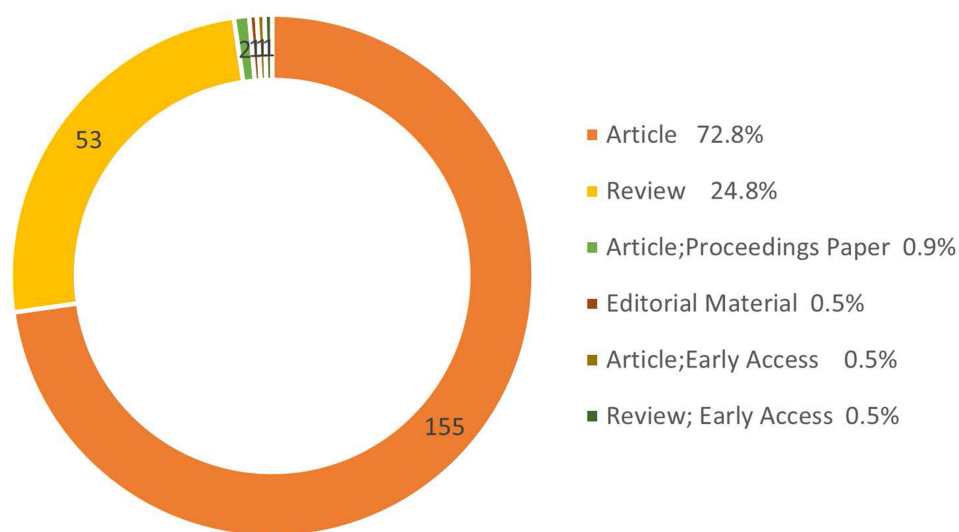


Figure 2 The type of publications on acupuncture for PC from 2003 to 2023.

Table 2 Top 10 Journal Categories Related to Acupuncture for PC

Rank	Publications	Journal Category	Rank	Publications	Journal Category
1	40	Integrative Complementary Medicine	6	19	Clinical Neurology
2	39	Medicine General Internal	7	16	Anesthesiology
3	39	Surgery	8	7	Oncology
4	23	Gastroenterology Hepatology	9	5	Pharmacology Pharmacy
5	21	Medicine Research Experimental	10	4	Multidisciplinary Sciences

results have wider influence and higher academic value, are more easily cited and applied by other scholars. The number of citations can also be used to evaluate the academic influence and research quality of researchers. At the same time, combining the intermediary centrality of the cited journals, we generated a map of the cited journals, which includes 437 nodes and 2706 links, as shown in Figure 3 and Table 3. The different nodes represent different journals, and the connection lines between different nodes represent the co-citation relationships. The more lines, the closer the connection. Nodes with different colors represent different years. The larger the area of the node, the more times it is referenced. The purple ring represents centrality, and nodes with centrality are considered to be the key points in the article. Through the table, we can see that the journal with the most citations is Evidence-Based Complementary and Alternative Medicine, and among these cited journals, the one with the highest centrality is Acupuncture in Medicine. The most cited article was “Stimulation of the wrist acupuncture point PC6 for preventing postoperative nausea and vomiting”.⁵⁵ The author believes that acupuncture stimulation of point PC6 can prevent postoperative nausea and vomiting. And there is no reliable evidence to suggest a difference between acupuncture and antiemetic drugs. Years later, he also pointed out in another article that there is currently higher-level evidence to prove that there is no significant difference between

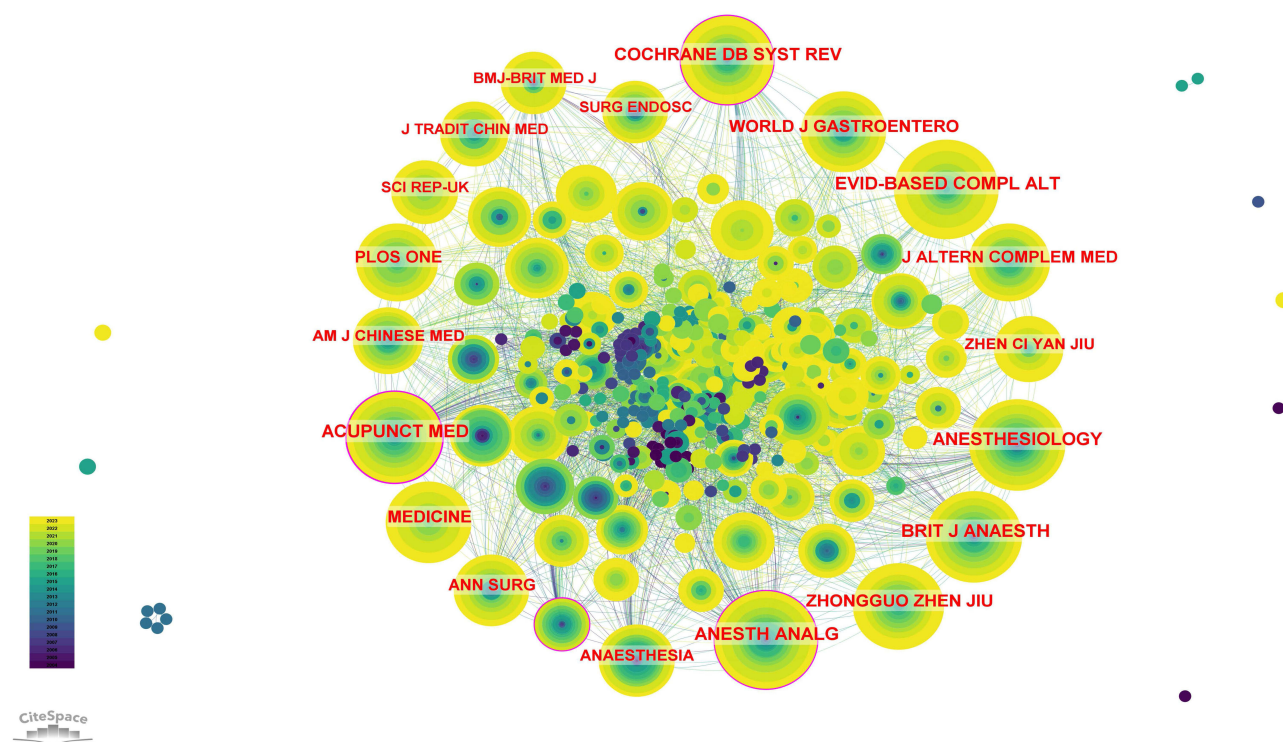
**Figure 3** Cited journal map related to acupuncture for PC from 2003 to 2023.

Table 3 Top 10 Cited Journals and Centrality Related to Acupuncture for PC

Rank	Cited Journal	Frequency	Rank	Cited Journal	Centrality
1	Evid-Based Compl Alt	76	1	Acupunct Med	0.21
2	Anesth Analg	74	2	Am J Gastroenterol	0.16
3	Acupunct Med	67	3	Anesth Analg	0.15
4	Brit J Anaesth	67	4	Cochrane DB Syst Rev	0.15
5	Anesthesiology	65	5	Acta Anaesth Scand	0.1
6	Cochrane DB Syst Rev	63	6	Anesthesiology	0.09
7	Zhongguo Zhen Jiu	59	7	AM J Chinese Med	0.09
8	World J Gastroentero	51	8	Ann Intern Med	0.08
9	Medicine	51	9	Brit J Anaesth	0.07
10	PLos One	48	10	BMJ-Brit Med J	0.07

acupuncture and antiemetics in preventing postoperative nausea and vomiting, and believes that acupuncture has no toxic side effects.⁵⁶ Using CiteSpace software, we produced a double-graph overlay of the journal and the cited journal (Figure 4). The left side represents the journal, and the right side represents the cited journal. There are two path links in the figure The green path indicates that research published in “medicine, medical and clinic” journals tends to cite journals mainly in the fields of “health, nursing, medicine” and “molecular, biology, genetics”. Indicating the close connection between these disciplines and providing direction for future research.

Distribution of Countries and Institutions

We generated a national network map with citespace, consisting of 31 nodes and 30 links (Figure 5). Different nodes represent different countries. Connections between different nodes indicate mutual cooperation. Researchers from 31 countries published the 213 articles, The distribution map of the number of national publications was created using Tableau

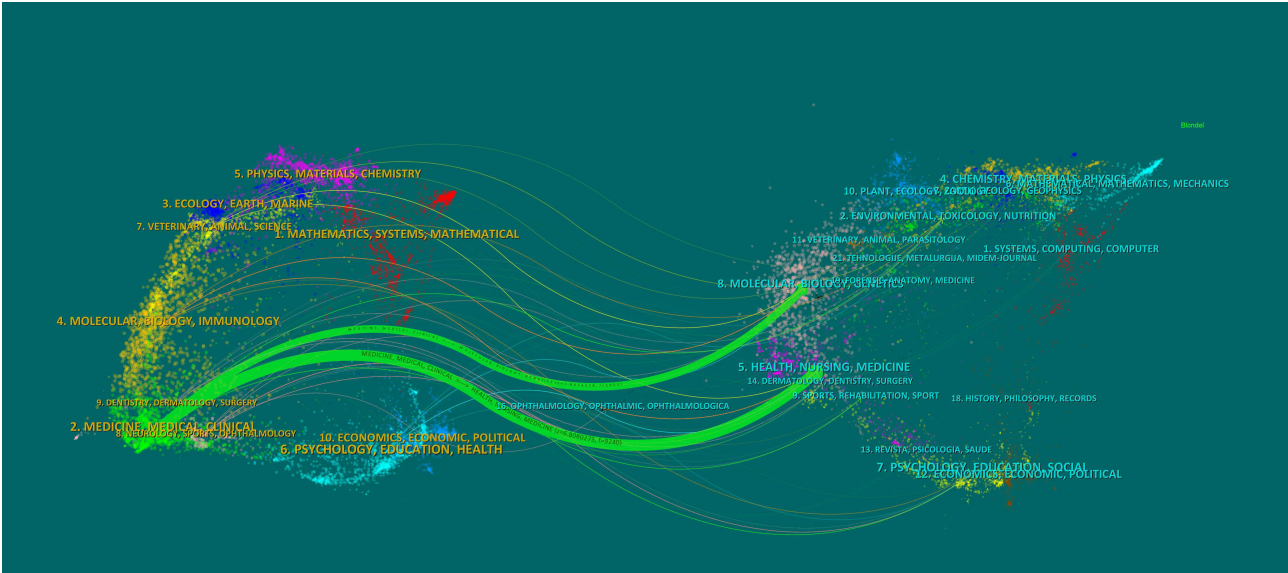


Figure 4 Dual-map overlay of journals related to Acupuncture for PC. The left side of the dual map is citing journals while the right side is cited journals, and the line in the middle indicates the association between them.



Figure 5 Map of countries researching acupuncture for PC from 2003 to 2023.

software, as shown in the [Figure 6](#): the top 10 publishing countries and the top 10 countries for centrality are shown in [Table 4](#). China published the most articles with 124, This indicates that China has the most research in this area, this may be related to the origin of acupuncture therapy in China, where it is the most routine treatment, followed by the United States with 32, SOUTH KOREA with 11, JAPAN with 10, GERMANY with 9, followed by the United States. This shows that PC of acupuncture treatment have been very common in the world, and many countries have studies in this area and the top 10 countries for centrality were the USA (0.47), the People's Republic of China (0.3), Germany (0.29), ITALY (0.16), JORDAN (0.08), ENGLAND (0.07), Australia (0.04), SWEDEN (0.01), the centrality of other countries is 0.

The distribution map of institutional contributions was also created through Citespace, consisting of 241 nodes and 282 connections ([Figure 7](#)). Different nodes in the figure represent different institutions. The connection represents cooperation between different institutions, indicating that a research achievement is jointly completed by multiple institutions. From the figure, We know that 241 institutions have participated in research on PC of acupuncture treatment, but we find that there is relatively little cooperation among institutions in different countries in this field of research, but there is closer cooperation among different institutions in China, especially among traditional Chinese medicine universities in Chengdu, Shanghai, Beijing, Nanjing, Guangzhou, and other places. The top 10 publishing institutions and the top 10 institutions for centrality are shown in [Table 5](#). From the table, we know that among these institutions, Capital Medical University in China not only published the most articles, but also had the highest centrality. It is not difficult to see that they have conducted a lot of research in this area and have relatively more connections with other institutions.

Analysis of Authors and Cited Authors

We also analyzed the author through Citespace and obtained 453 nodes and 767 connections. ([Figure 8](#)). Different nodes in the figure represent different authors, and the connections between authors represent their mutual cooperation. Through the figure, we know that these articles were co authored by 453 authors, and there have been 767 collaborations

Country distribution map



Figure 6 Map of the country distributions.

between them. Through this author contribution graph, we can also know who has the highest publication volume and which authors are closely related. This is very helpful for our future research in this area, providing us with potential partners and possibilities for better research. The top 10 authors in terms of publication volume are shown in Table 6, Among the top 10 authors in terms of publication volume, only Zhu and Junchao have published 3 articles, while the others have only published 2 articles. The number of articles published in this area is not large, indicating that research is

Table 4 Top 10 Publications and Centrality of Countries Related to Acupuncture for PC

Rank	Publications	Countries	Rank	Centrality	Countries
1	124	Peoples R China	1	0.47	USA
2	32	USA	2	0.3	Peoples R China
3	11	South Korea	3	0.29	Germany
4	10	Japan	4	0.16	Italy
5	9	Germany	5	0.08	Jordan
6	6	Taiwan	6	0.07	England
7	5	England	7	0.04	Australia
8	5	Australia	8	0.01	Sweden
9	4	Turkey	9	0	South Korea
10	4	France	10	0	Japan

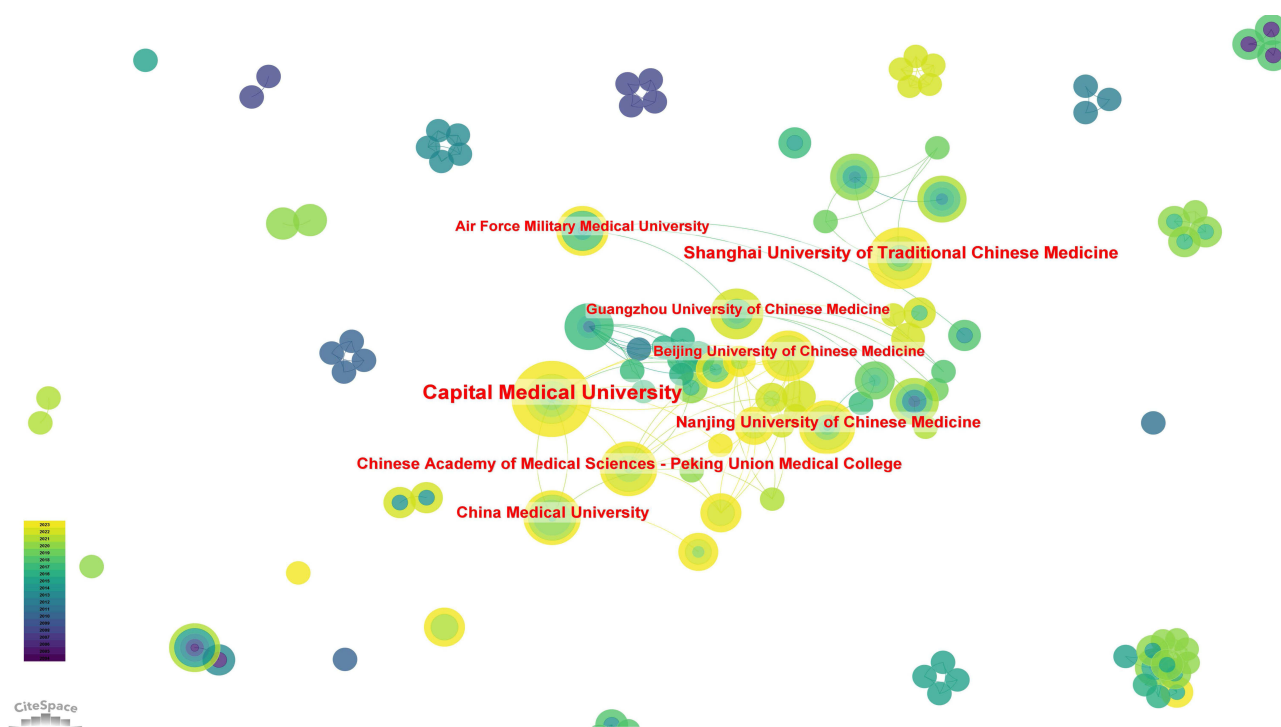


Figure 7 Map of institutions researching acupuncture for PC from 2003 to 2023.

not yet in-depth and is still in the initial stage. On the other hand, the impact factors of all published articles in our direction are generally not high, which may be related to insufficient research depth, failure to design strict experimental plans, and failure to provide high-level evidence. So it suggests that we can increase investment in this area of research in the future and design more rigorous and reasonable experimental plans.

Table 5 Top 10 Publications and Centrality of Institutions Related to Acupuncture for PC

Rank	Publications	Institutions	Rank	Centrality	Institutions
1	12	Capital Medical University	1	0.02	Capital Medical University
2	8	Chengdu University of Traditional Chinese Medicine	2	0.02	Nanjing University of Chinese Medicine
3	7	Shanghai University of Traditional Chinese Medicine	3	0.02	Beijing University of Chinese Medicine
4	6	Chinese Academy of Medical Sciences - Peking Union Medical College	4	0.02	Guangzhou University of Chinese Medicine
5	6	China Medical University	5	0.02	Royal Melbourne Institute of Technology (RMIT)
6	6	Nanjing University of Chinese Medicine	6	0.02	Tianjin University of Traditional Chinese Medicine
7	5	Beijing University of Chinese Medicine	7	0.01	Chinese Academy of Medical Sciences - Peking Union Medical College
8	5	Guangzhou University of Chinese Medicine	8	0.01	China Medical University
9	5	Air Force Military Medical University	9	0.01	University of California System
10	5	Chinese University of Hong Kong	10	0.01	Peking University

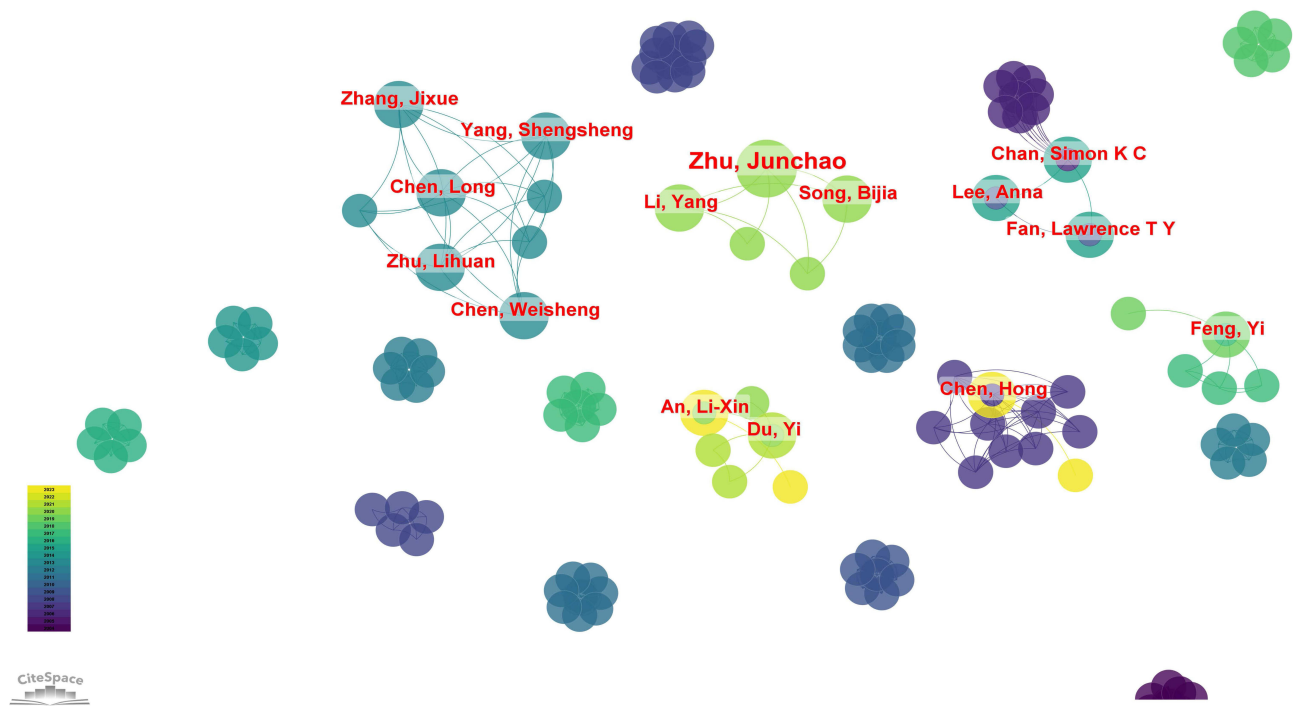


Figure 8 Map of authors related to acupuncture for PC from 2003 to 2023.

Through Citespace, we have created a citation author graph consisting of 631 nodes and 2354 lines (Figure 9). The most cited is [ANONYMOUS] (38), following by GAN TJ (29), LEE A (23), LIU YH (19) and NG SSM (18) (Table 7). Top 10 centrality of cited authors included LEE A (0.18), BALTIMORE RS (0.16), [ANONYMOUS] (0.15), WANG H (0.1), APFEL CC (0.09), NG SSM (0.08), HAN JS (0.08), WU MS (0.06), AGARWAL A (0.06), COMBES X (0.06) (Table 8).

Analysis of Cited References

Through Citespace software, we have created a reference map consisting of 554 nodes and 1738 lines, as shown in Figure 10. We can know the citation frequency and centrality of references through charts. The top 10 citation frequencies are shown in Table 8, and the top 10 centrality are shown in Table 9. Through the analysis of these references, we can know the research hotspots of this topic. The literature with the highest citation frequency and centrality is the same one, published by Liu Yuh as “Acquisition and Related Treaties for Treatment of Postoperative Ileus in Colorectal Cancer: A Systematic Review and Meta Analysis of Randomized Controlled Trials”.⁵⁷ The author points out that acupuncture treatment after cancer surgery can improve the recovery of gastrointestinal function. Yang Nana et al⁵⁸ believe that electroacupuncture can reduce local inflammation in the intestinal muscle tissue of Postoperative ileus to protect SMC and improve gastrointestinal transport. Different acupoints have different therapeutic effects on

Table 6 Top 10 Prolific Authors Related to Acupuncture for PC

Rank	Publications	Author	Rank	Publications	Author
1	3	Zhu, Junchao	6	2	Wagh, MS
2	2	Huo, Jian	7	2	Zhang, Jixue
3	2	Feng, Yi	8	2	Chen, Long
4	2	Chen, Weisheng	9	2	Yang, Shengsheng
5	2	Li, Yang	10	2	Zhang, Jingyuan

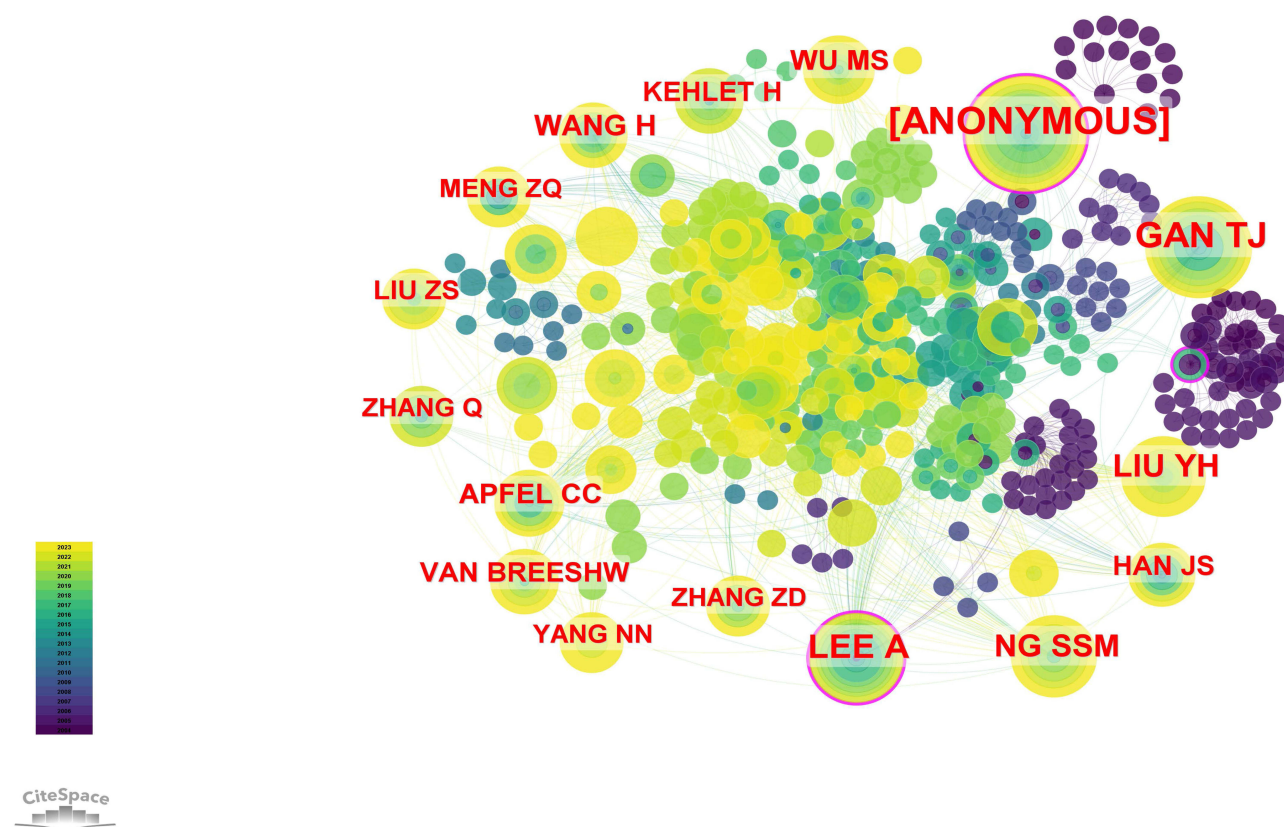


Figure 9 Map of cited authors related to acupuncture for PC from 2003 to 2023.

postoperative movement disorders and inflammation in rats. Gao Wei and others believe that transcutaneous acupoint electrical stimulation may reduce the incidence of postoperative paralytic intestinal obstruction and enhance the recovery of gastrointestinal function by regulating the tension of parasympathetic nerve and its anti-inflammatory effect.⁶⁰

Table 7 Frequency and Centrality of the Top 10 Cited Authors Related to Acupuncture for PC

Rank	Frequency	Author	Rank	Centrality	Author
1	38	[Anonymous]	1	0.18	Lee A
2	29	Gan TJ	2	0.16	Baltimore RS
3	23	Lee A	3	0.15	[Anonymous]
4	19	Liu YH	4	0.1	Wang H
5	18	Ng SSM	5	0.09	Apfel CC
6	14	Wang H	6	0.08	Ng SSM
7	13	Apfel CC	7	0.08	Han JS
8	13	Wu MS	8	0.06	Wu MS
9	12	Han JS	9	0.06	Agarwal A
10	12	Kehlet H	10	0.06	Combes X

Table 8 Top 10 Frequency of Cited References Related to Acupuncture for PC

Rank	Frequency	References	Author and Publication Year
1	15	Evid-Based Compl Alt, V2018, P0, DOI 10.1155/2018/3178472	Liu YH, 2018 ⁵⁷
2	9	Neurogastroent Motil, V32, P0, DOI 10.1111/nmo.13808	Yang NN, 2020 ⁵⁸
3	8	Int J Surg, V73, P57, DOI 10.1016/j.ijisu.2019.10.036	Chen JB, 2020 ²³
4	8	Cochrane Db Syst Rev, V0, P0, DOI 10.1002/14651858.CD003281.pub4	Lee A, 2015 ⁵⁶
5	7	J Neurosurg Anesth, V29, P219, DOI 10.1097/ANA.0000000000000290	Asmussen S, 2017 ⁵⁹
6	7	Surgery, V170, P1618, DOI 10.1016/j.surg.2021.08.007	Gao W, 2021 ⁶⁰
7	6	Clin Nutr, V34, P367, DOI 10.1016/j.clnu.2015.01.016	Bragg D, 2015 ⁶¹
8	6	PLos One, V11, P0, DOI 10.1371/journal.pone.0150367	Wu MS, 2016 ⁶²
9	6	Int J Surg, V70, P93, DOI 10.1016/j.ijisu.2019.08.034	Chen KB, 2019 ⁶³
10	6	Clin Interv Aging, V13, P2127, DOI 10.2147/CIA.S183698	Gao F, 2018 ⁶⁴

Analysis of Keywords

Keywords, as the name suggests, refer to the key information of a paper, which not only reflects the main content of the paper, but more importantly, makes your paper easier to search for, thereby increasing the number of citations. The frequency of keyword occurrences reflects the hotspots in the research field. The more frequently keywords appear, the larger the font display in the graph and the larger the nodes. Burst words refers to the highly frequent occurrence of keywords in a published article in a short period of time. From the beginning to the end of keyword emergence, a black horizontal line mark is formed, indicating the importance and attention of the keyword in the research field. The longer the emergence length, the longer the duration of the keyword popularity and the stronger the research frontiers. A keyword co-occurrence graph consisting of 379 nodes and 1569 links was generated, as shown in Figure 11. By analyzing the frequency and centrality of keywords, we found that the most frequently used keywords are “acupuncture”, “electroacupuncture”, “surgery”, “management”, “complications”, “recovery”, “pain”, “anesthesia”, “efficacy” and “meta analysis”, as shown in Table 10. We also created a Burst words chart, as shown in Figure 12 which shows the top 10 keywords with the strongest citation outbreaks from 2003 to 2023. The emergence chart can reflect the research frontiers, emergence intensity, and duration of different time periods. It can provide us with good guidance for our research. We found that keyword emergence first appeared in 2004. This shows that acupuncture treatment of post-operative complications started in 2004 and belongs to a new research direction. Among the top 10 keywords, we found three hotspots starting from 2023: “meta analysis”, “recovery”, “enhanced recovery”.

Mate analysis is a systematic quantitative analysis of past research results through integration, quantification, comparison, statistical analysis, etc.⁷⁰ in order to draw more accurate conclusions and delve deeper into the overall picture and essence of a certain thing or phenomenon. Meta analysis can take into account a large amount of evidence on a certain topic, which greatly enhances research in this field and provides support for practical applications.⁷¹ Recovery and enhanced recovery refers to enhanced recovery after surgery (ERAS), also known as fast track surgery (FTS),⁷² it adopts a series of evidence-based medicine proven effective perioperative optimization measures to reduce surgical stress

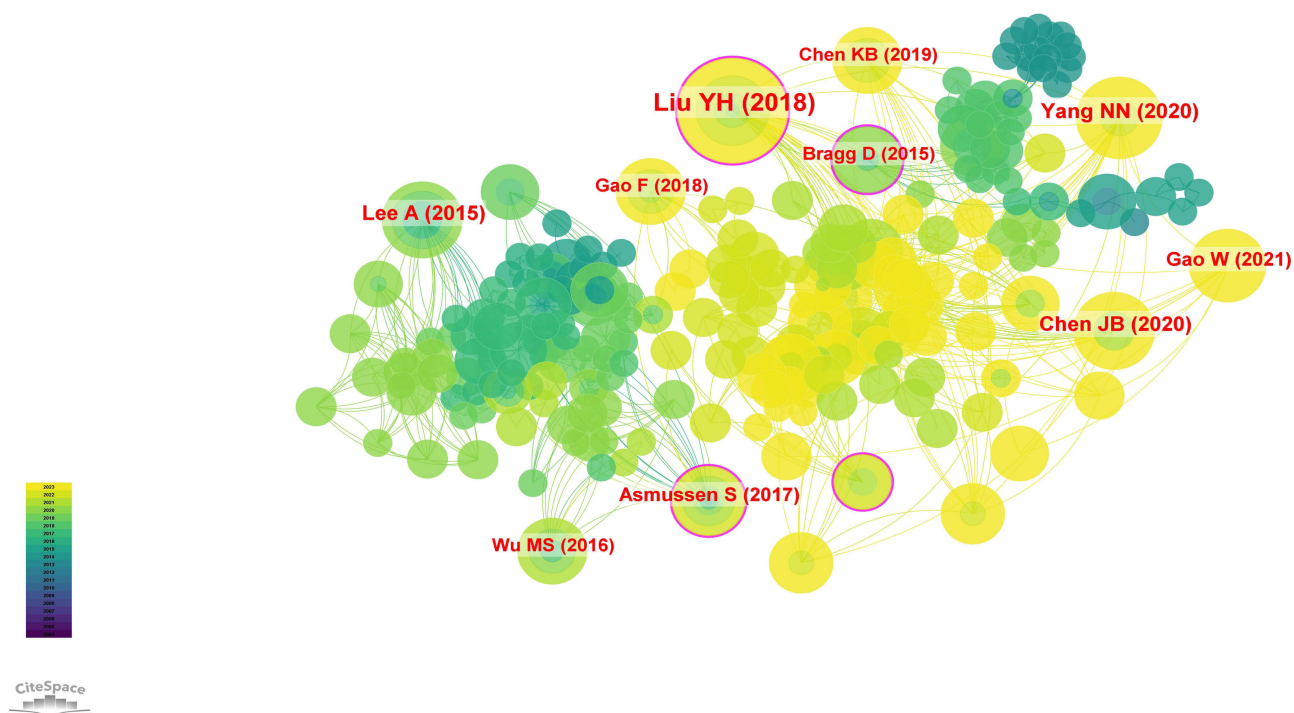


Figure 10 Map of cited references related to acupuncture for PC from 2003 to 2023.

and accelerate postoperative recovery, controlling inflammation, reducing stress reactions, and applying them.⁷³ ERAS can effectively, reasonably, and moderately improve conventional treatment processes, reduce surgical stress reactions, reduce surgical complications, and reduce surgical risks, thereby accelerating patient recovery, shortening postoperative hospitalization time, reducing hospitalization costs, improving postoperative patient quality of life, improving patient surgical experience, and increasing satisfaction.⁷⁴ The core of ERAS is to minimize the stress response of the body during surgery, block the transmission of stress signals by afferent nerves, and thereby alleviate the psychological and physical damage of patients.⁷⁵

Table 9 Top10 Centrality of Cited References Related to Acupuncture for PC

Rank	Centrality	References	Author and Publication Year
1	0.13	Evid-Based Compl Alt, V2018, P0, DOI 10.1155/2018/3178472	Liu YH, 2018 ⁵⁷
2	0.12	J Neurosurg Anesth, V29, P219, DOI 10.1097/ANA.0000000000000290	Asmussen S, 2017 ⁵⁹
3	0.12	Clin Nutr, V34, P367, DOI 10.1016/j.clnu.2015.01.016	Bragg D, 2015 ⁶¹
4	0.1	J Anesth, V31, P58, DOI 10.1007/s00540-015-2057-1	Huang S, 2017 ⁶⁵
5	0.08	Clin Interv Aging, V13, P2127, DOI 10.2147/CIA.S183698	Gao F, 2018 ⁶⁴
6	0.08	Neuron, V108, P436, DOI 10.1016/j.neuron.2020.07.015	Liu SB, 2020 ⁶⁶

(Continued)

Table 9 (Continued).

Rank	Centrality	References	Author and Publication Year
7	0.06	J Integr Med-Jim, V19, P211, DOI 10.1016/j.joim.2021.01.005	Li WJ, 2021 ⁶⁷
8	0.06	J Neurosurg Anesth, V30, P337, DOI 10.1097/ANA.0000000000000460	Bai WY, 2018 ⁶⁸
9	0.04	Cochrane Db Syst Rev, V0, P0, DOI 10.1002/14651858.CD003281.pub4	Lee A, 2015 ⁵⁶
10	0.04	Anesth Analg, VI18, P85, DOI 10.1213/ANE.0000000000000002	Gan TJ, 2014 ⁶⁹

Results

PC came into being with surgery. In the past, people focused on how to improve the success rate of surgery. They did not pay enough attention to postoperative rehabilitation of patients, and acupuncture research in this area was even less. With the rise of enhanced recovery after surgery, high attention is paid to surgical complications, acupuncture has played a unique role in this respect, which has attracted more and more attention.⁷⁶

This study is the first bibliometric study on PC of acupuncture treatment. The research results are as follows:

(1) From 2003 to 2012, research remained relatively stable, with little change in annual publication volume; From 2012 to 2016, research fluctuated significantly, with an increase and decrease in annual publication volume; Since 2016, the annual publication volume has shown an exponential increase, indicating that people’s attention to this field has been increasing since 2016, making it a research hotspot.

(2) Acupuncture still plays the role of comprehensive complementary medicine in treating PC. The most cited journal is Evidence-Based Complementary and Alternative Medicine.

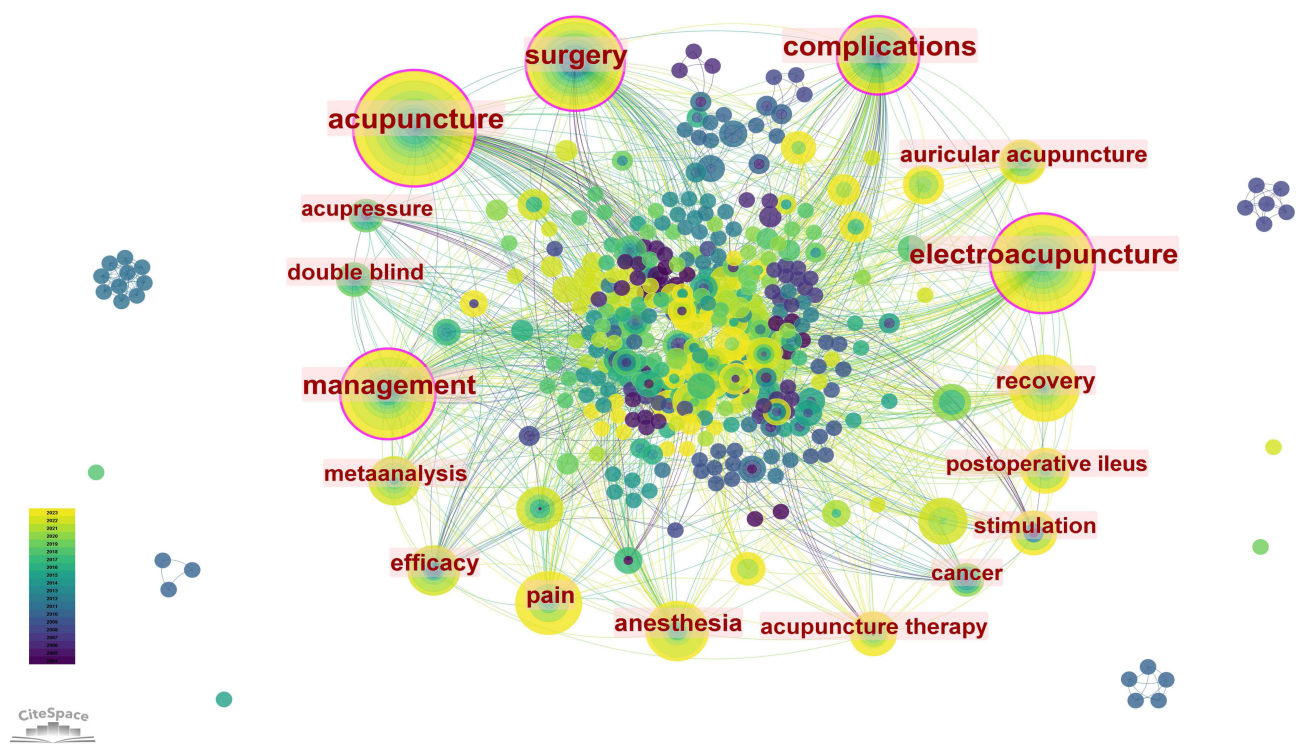


Figure 11 Map of keywords occurrence related to acupuncture for PC from 2003 to 2023.

Table 10 Top 10 Frequency and Centrality of Keywords Related to Acupuncture for PC

Rank	Keyword	Frequency	Rank	Keyword	Centrality
1	Acupuncture	62	1	Complications	0.37
2	Electroacupuncture	43	2	Surgery	0.35
3	Surgery	40	3	Acupuncture	0.34
4	Management	35	4	Management	0.26
5	Complications	29	5	Electroacupuncture	0.22
6	Recovery	20	6	Cancer	0.1
7	Pain	18	7	Anesthesia	0.08
8	Anesthesia	16	8	Auricular acupuncture	0.08
9	Efficacy	13	9	Appendectomy	0.08
10	Meta analysis	11	10	Meta analysis	0.07

(3) The country with the highest number of publications is China, and the institution with the highest number of publications is the Capital Medical University in China. It shows that there are a lot of researches in this field in China. As a traditional medicine in China, acupuncture is widely used, and its curative effect is also very significant.

(4) The author with the highest number of publications is Zhu, Junchao. The most central cited author is LEE A.

(5) The articles with the highest frequency and centrality of cited references are published by Liu, Y. H.

(6) The most frequently studied keywords are acupuncture, electroacupuncture, surgery, management, complications, etc, and the same applies to burst words. Acupuncture is a hot topic in current research on postoperative management and the treatment of postoperative complications.

Discussion

Enhanced recovery after surgery (ERAS) is one of the important development directions leading the progress of modern surgical technology in the 21st century. ERAS is not a new surgical technique, but a new concept of perioperative management, which is an important supplement to traditional surgery.⁷⁵ The core principle of ERAS is to reduce surgical stress response and thereby reduce the risk of complications through a multimodal approach. The ERAS operating mode

Top 10 Keywords with the Strongest Citation Bursts

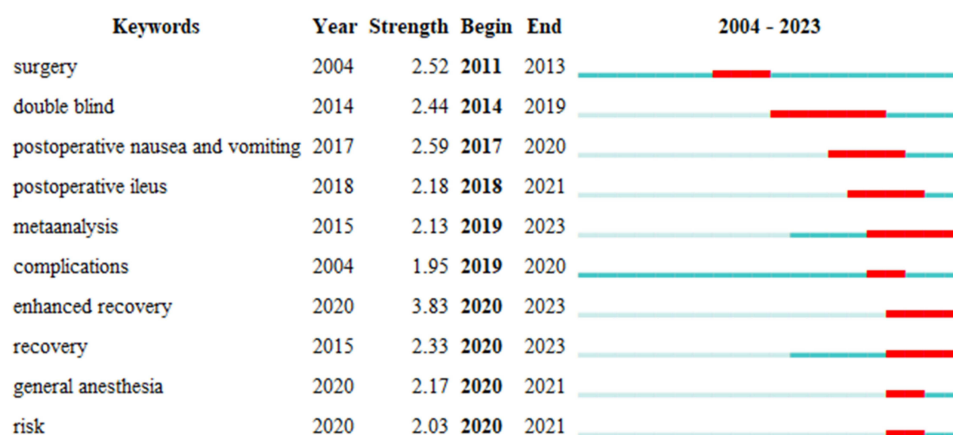


Figure 12 Top 10 keywords with the strongest citation bursts. The red bars demonstrated that the keyword was cited frequently, the green bars showed that the keyword was cited infrequently.

is a multidisciplinary collaboration (MDT), which includes disciplines such as surgery, anesthesia, nursing, surgical care, nutrition, psychology, rehabilitation, as well as cooperation between patients and their relatives, which is the prerequisite for conducting ERAS.⁷⁷ It is necessary to emphasize the importance of patients and their relatives actively participating and cooperating, otherwise the effectiveness of ERAS cannot be fully utilized. In MDT, various disciplines optimize perioperative management measures and reengineer surgical procedures. Common measures include preoperative education, preoperative evaluation and prevention of complications, shortening preoperative fasting time, encouraging the use of minimally invasive surgery, short-term general anesthesia and local anesthesia, multimodal analgesia, minimizing drainage placement, early oral feeding after surgery, early bed activity, and early catheter removal.⁷⁸ Each optimization measure should be supported by evidence-based medical evidence. In preoperative, intraoperative, and postoperative management, the perioperative MDT combination should be applied to the same patient, closely collaborating and consistently, to achieve the best results, reduce pain and risk, and achieve rapid recovery.^{17,79} In July 2015, the first academic Annual Conference of ERAS was held in China. In December 2016, the Expert Committee of ERAS of the National Health and Family Planning Commission was established. This marked that the promotion and application of ERAS had entered China's national strategy, and thus the concept of ERAS came into the public eye. Acupuncture, as a characteristic treatment method of traditional Chinese medicine, plays a very important role in the construction of ERAS. Acupuncture can improve basic problems such as preoperative anxiety, insomnia and chronic pain, and enhance the surgical tolerance of patients. Help patients optimize their nutritional status and reduce the risk of postoperative complications; In cooperation with the anesthesiology department, acupuncture can reduce the dosage of anesthetic drugs, lower the incidence of postoperative nausea and vomiting, and shorten the recovery time from anesthesia. It can reduce opioid dependence, lower side effects, shorten postoperative recovery time and decrease complications. It not only promotes multidisciplinary cooperation, but also is a perfect combination of traditional medicine and modern medicine. Therefore, since 2016, the number of articles on acupuncture treatment for postoperative complications of surgery has increased significantly.

Conclusion

In summary, this study analyzes the current research hotspots, research institutions, countries, regions, and potential research directions, as well as research partners. It is believed that acupuncture, as a supplementary medicine, is widely used in postoperative complications, especially in areas such as gastrointestinal dysfunction, postoperative pain, and postoperative intestinal obstruction. It is of great significance for accelerating the construction of rehabilitation surgery and is worth promoting.

Data Sharing Statement

Raw data were obtained directly from the Web of Science Core Collections (WoSCC).

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Author Contributions

All authors made significant contributions to article topic selection, conception and design, literature search, data acquisition, or data analysis and interpretation; participated in drafting, authoring, or critically revising articles of significant intellectual content; final approval for the forthcoming edition; and agree to be responsible for all aspects of the job.

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Disclosure

The authors report no conflicts of interest in this work.

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