Bibliometric and visual analysis of post-stroke hemiplegia in the past 20 years

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Author contributions
Jie Li searched and collected the literature, designed the research program and wrote the paper. Xue-Min Yin, Yong-Fang Yang analyzed data and plotted. Jie Li revised the paper. Xin-Ju Li provided technical guidance and financial support.

Competing interests
The authors declare no conflicts of interest.

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Abstract
Objective: The purpose of this study is to use CiteSpace software to examine the development patterns and hotspots in post-stroke hemiplegia research during the last 20 years. Methods: Articles about post-stroke hemiplegia from January 2005 to December 2024 were analyzed in the Web of Science database. CiteSpace software was used to conduct co-citation analysis of the articles about post-stroke hemiplegia as well as cooperative network analyses of authors, countries, and institutions, as well as keyword co-occurrence, clustering, emergence, and time line analyses. The results were displayed in a visual atlas. Result: A total of 2625 papers were obtained, and there were more publications overall. China and the United States had the most number of articles, while Chae, John was the author with the most number of articles. Capital Med University and Ohio State University had the most articles among their agencies. The keywords ‘stroke’ and ‘rehabilitation’ were used the most. The key word analysis indicates that the present study focus is on exercise rehabilitation measures and post-stroke treatment. Conclusion: Using CiteSpace software to analyze the literature on post-stroke hemiplegia, it is discovered that the use of new technologies in the field of mechanical thrombectomy and the effectiveness of rehabilitation techniques like mirror treatment are the key areas of study attention. This study has positive significance for finding safer and more effective treatments for post-stroke hemiplegia.

Keywords: CiteSpace; stroke; hemiplegia; visual analysis

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**Introduction**

Stroke is a type of cerebrovascular disease that manifests as motor disorders, sensory disorders, speech disorders, visual disorders or other cognitive, emotional, behavioral disorders in individuals as a result of arterial rupture or abnormalities in cerebral blood circulation [1, 2]. Among the common risk factors include smoking, diabetes, hypertension, and hyperlipidemia [3]. In addition, stroke ranks first globally in terms of both mortality and long-term disability [3]. According to the survey, in 2020, the global incidence of stroke was 11.71 million [4]. The report indicates that the incidence of stroke is rising annually in China as a result of changes in the socioeconomic structure of the country's aging population and way of life [5]. Notably, the above-mentioned conditions cause hemiplegia in half of stroke survivors, leading to severe neurological impairment that primarily presents as dyskinnesia, balance disorder, language disorder, and dysphagia [6], all of which have a negative impact on patients' quality of life. Rehabilitation training is currently mostly utilized in clinical settings in conjunction with medications, physical therapy, and other strategies to aid in the restoration of limb and language function; yet, there are still several drawbacks, including a protracted treatment regimen, large treatment cost burden, leading to poor compliance and unsatisfactory results [7]. In traditional Chinese medicine, the combined intervention of multiple methods is mainly adopted, including acupuncture, Chinese herbal decoctions, and Tuina therapy. Therefore, individualized treatment can be carried out, and the clinical efficacy can be further improved [8].

In recent years, the consequences of stroke have garnered increasing attention from various sectors. However, there has been no systematic organization and analysis of the literature on post-stroke hemiplegia. Bibliometrics can analyze all forms of knowledge carriers using mathematical and statistical methods [9]. CiteSpace can analyze and visualize the literature hotspots and research frontiers in a specific field within a certain period of time through bibliometrics, co-occurrence analysis, and clustering analysis [10]. Therefore, in this paper, Web of Science was selected as the database for literature extraction, and CiteSpace software was used to conduct bibliometric analysis of the relevant literature on post-stroke hemiplegia in the past 20 years. This analysis aimed to summarize the research status and identify hot spots in the field of post-stroke hemiplegia.

**Method**

**Data sources and retrieval strategies**

All data were sourced from the core collection of the Web of Science database. The search expression was: (TS = ‘hemiplegia’ OR ‘hemiplegia, transient’ OR ‘monoplegia’ OR ‘hemiplegia, Post-ictal’ OR ‘Hemiplegias, Post-ictal’ OR ‘hemiplegia, Crossed’ OR ‘Hemiplegias, Crossed’ OR ‘hemiplegia, Flaccid’ OR ‘Hemiplegias, Flaccid’ OR ‘hemiplegia, Infantile’ OR ‘Hemiplegias, Infantile’ OR ‘hemiplegia, Spastic’ OR ‘Hemiplegias, Spastic’) AND (TS = ‘Stroke’ OR ‘Strokes’ OR ‘post stroke’ OR ‘poststroke’ OR ‘brain infarction’ OR ‘cerebral infarction’ OR ‘Cerebrovascular Accident’ OR ‘Cerebrovascular Accidents’ OR ‘CVAs (Cerebrovascular Accident)’ OR ‘CVAs (Cerebrovascular Accident)’ OR ‘Apoplexy, Cerebrovascular’ OR ‘Vascular Accident, Brain’ OR ‘Brain Vascular Accident’ OR ‘Vascular Accidents, Brain’ OR ‘Stroke, Cerebrovascular’ OR ‘Strokes, Cerebrovascular’ OR ‘Apoplexy’ OR ‘Stroke, Cerebral’ OR ‘Strokes, Cerebral’ OR ‘Stroke, Acute’ OR ‘Strokes, Acute’ OR ‘Cerebrovascular Accident, Acute’ OR ‘acute Cerebrovascular Accident’ OR ‘acute Cerebrovascular Accidents’ OR ‘Cerebrovascular Accidents, Acute’)). The data can be retrieved from January 1, 2005, to April 29, 2024, in any language.

**Criteria for literature inclusion and exclusion**

Articles such as clinical studies, basic studies, and literature studies on post-stroke hemiplegia were included. Excluded were Correction, Retraction, Retracted Publication, Letter, Book Chapters, Early Access, Editorial Material, Meeting Abstract, Proceeding Paper, and articles not in English.

**Data specification**

The retrieved terms 'England', 'Scotland', 'Wales' and 'Northern Ireland' were normalized as 'UK'; 'peoples_r_china' and 'taiwain' were both officially referred to as 'China'; the term 'Turkey' is specified as 'turkiye.' Since there were no similar meanings or alternative expressions of the keywords retrieved in this paper, all of them were included in the analysis.

**Data analysis**

In the core collection of Web of Science, the retrieved articles were exported, and the contents of the records were selected as ‘full records and cited references’. The searched articles were exported and downloaded as plain text documents. Duplicate entries were identified, stored in duplicate-removed records using CiteSpace (version 6.2.R7), and then included in the literature after screening. CiteSpace parameters were set from January 2005 to April 2024. One year was selected as the time slice for segmentation. The g-index (k = 5) was used for node screening. Lexical types include title, abstract, author keywords, and Keywords Plus. The node types included country, institution, author, cited author, cited reference, and keyword. The software was run sequentially to generate charts for the annual published documents and the annual accumulated published documents. The various charts depicting the country, institution, author, and keyword were created to analyze the research status, hotspots, and development trends in the field.

**Diagram**

Nodes in the atlas represent study authors, study institutions, and keywords. The size of a node circle represents the frequency of appearance, with larger circles indicating higher appearance frequencies. The color of that circle represents the year. The connections between nodes indicate co-occurrence frequency. The more connections, the stronger the correlation between the two.

**Results**

A total of 3,072 articles were retrieved. Excluded articles included: Correction (n = 3), Retraction (n = 4), retraced publication (n = 15), Letter (n = 20), Book Chapters (n = 21), Early Access (n = 22), Editorial Material (n = 25), Meeting Abstract (n = 36), Proceeding Paper (n = 226), No-English (n = 75), totaling 447 articles. Among the remaining 2,625 articles, 227 (8.64%) were reviews, while the other 2,398 articles accounted for 91.36%.

**Post situation analysis**

As shown in Figure 1, the number of articles published in the field of post-stroke hemiplegia increased gradually from 2005 to 2015, experienced a sharp increase from 2017 to 2021, peaked in 2021, and then remained consistently high. However, the number of published articles decreased significantly in 2024, which was considered to be related to the retrieval time. In general, the number of articles concerning post-stroke hemiplegia increased from 2005 to 2024.

**Author collaboration analysis**

Click on ‘Author’ in CiteSpace software to generate an author collaboration map with 186 nodes and 125 connections (Figure 2). The network density was calculated to be 0.0073. According to data analysis, the top 5 authors and their articles were Chae, John (16), Page, Stephen J (13), Jang, Sung Ho (9), Fotopoulou, Aikaterini (8), and Gao, Fan (6), respectively. Among them, Chae, John has the closest relationship with other authors and have published articles with five authors. Therefore, Chae, John may have great reference value in the field of post-stroke hemiplegia. Chae, John focuses on neuromuscular electrical stimulation (NMES) in the rehabilitation process after stroke. Because paralysis after stroke is one of the common manifestations, it can lead to a decrease in the rate of voluntary activation of the affected limb and an inability to produce
functionally useful movement. NMES is the use of electric current to produce contraction of paralyzed or paralyzed muscles, and can be used as a motor relearning tool to train the affected muscle to produce functional movement [11]. At the same time, NMES can also prevent muscle atrophy, deep vein thrombosis, and improve tissue oxygenation and cardiopulmonary regulation [12]. However, the implementation of the neuroprosthesis system, including the reliable control range and the appropriate level of stimulation, depends on the technological development of other disciplines, and will require continuous exploration and development in the future [13]. At the same time, he also focused on the research trends of local pain after stroke.

Analysis of national and institutional cooperation
Click on “country” in CiteSpace software and select “Minimum Spanning Tree” as the cutting mode to generate the map of the national cooperative network with 85 nodes, 275 connections, and a network density of 0.077 (Figure 3). The countries that were ranked in the top 5 in terms of publication frequency and their publication volume were CHINA with 535 publications, USA with 494 publications, JAPAN with 299 publications, SOUTH KOREA with 264 publications, and UNITED KINGDOM with 162 publications. Click on “institution” in the software, and choose “Minimum Spanning Tree” as the cutting method to generate the cooperative network diagram of institutions with 175 nodes, 88 connections, and a network density of 0.0058 (Figure 4). The institutions that ranked in the top 5 in terms of posting frequency and their posting volume were OHO STATE UNIV (n = 24), Capital MED UnIV (n = 23), Case Western Reserve UNIV (n = 21), Fujita HLTH UnIV (n = 19), and Fudan UNIV (n = 17). In recent years, Capital Med Univ has published a large number of papers, mainly focusing on the risk factors and evaluation indicators of short-term or long-term prognosis of stroke. It had been pointed out in the literature that the risk of stroke recurrence is different for the type of single cerebral infarction, such as cortical lesion and subcortical lesion with different diameter, which is completely different from multiple acute infarction [14]. In addition, higher YKL-40 levels at admission were found to be associated with short and long-term stroke death, but not with recurrence after ischemic stroke [15]. Other animal experiments have found that chronic restraint stress aggravates infarct volume and nerve function deficits after middle cerebral artery occlusion in mice, accompanied by increased levels of apoptosis (cell death and protein expression), which is associated with increased levels of transporter protein (TSPO) [16]. In general, Capital Med UnIV’s papers are of high quality and highly referential, making more contributions to the management of stroke risk factors, the intervention of prognosis and rehabilitation, and the exploration of mechanisms.

![Figure 1 Trend chart of annual publication volume (2005–2024)](https://www.tmrjournals.com/tcr)

![Figure 2 Collaborative analysis of authors of relevant studies on post-stroke hemiplegia (2005–2024)](https://www.tmrjournals.com/tcr)
Keywords analysis
Keywords co-occurrence analysis. Click on 'Key word' in CiteSpace software, and select "Pathfinder" for the cutting mode to generate a keyword co-occurrence map with 157 nodes and 188 connections (Figure 5). The top 10 keywords in terms of occurrence frequency were "stroke" 511 times, "rehabilitation" 386 times, "hemiplegia" 374 times, "recovery" 360 times, "reliability" 360 times, "performance" 179 times, "upper extremity" 174 times, "stroke patient" 170 times, "walking" 161 times, and "therapy" 139 times.

Keywords clustering analysis. In clustering analysis, a clustering module value (Q) > 0.3 indicates a significant clustering structure, while a clustering average contour value (S) > 0.5 suggests reasonable clustering. Moreover, when S > 0.7, it signifies a convincing clustering result [17]. Through the analysis, the top 11 keywords for clustering analysis are rehabilitation, acute ischemic stroke, motor recovery, neglect, upper limb, walking, stroke rehabilitation, cerebral palsy, children, cerebral infarction and upper extremity. The keyword clustering analysis atlas was created (Figure 6). The analysis results of the atlas show that Q = 0.775 and S = 0.9125, indicating a significant clustering structure and convincing results.

Keywords emergence analysis. Performing burst analysis on the keywords involves obtaining the first 25 keywords with higher emergent intensity and creating a burst analysis chart of the keywords (Figure 7). The results showed that the keywords with higher burst intensity were ischemic stroke, randomized controlled trial, cerebrovascular accident, people, acute ischemic stroke. Since 2008, the research perspective has shifted from focusing solely on diseases to prioritizing people, with an emphasis on improving the quality of life for patients with post-stroke hemiplegia. In recent years, new treatment and rehabilitation methods for post-stroke hemiplegia have emerged, such as mechanical thrombectomy and mirror therapy.
Keywords timeline analysis. Based on the atlas of keyword clustering analysis, the timeline was drawn using local linear regression (Figure 8). From 2005 to 2010, research hotspots focused on the rehabilitation of post-stroke hemiplegia, with more emphasis on cerebral infarction and upper limb function. From 2010 to 2015, the research focus shifted to the rehabilitation of upper limb function after a stroke. From 2015 to 2020, the research focus shifted to clinical observation and evaluation methods, including virtual reality and statistical analysis. From 2020 to 2024, with advancements in medical treatment, the research focus shifted towards further investigating the mechanism of post-stroke hemiplegia through brain-computer interfaces, pathophysiology, and other aspects. This led to new breakthroughs in the treatment and assessment of post-stroke hemiplegia, such as brain-computer interface, mirror therapy, mechanical thrombectomy, ankle-foot orthoses, intracerebral hemorrhage quality, Barthel Index, Modified Ashworth Scale, etc. The emergence of brain-computer interfaces (BCI) as new technologies is a system that can provide instructions based on activities recorded by electrodes on the scalp, cortical surface, or brain, without relying on muscles. It can also be used in programs to enhance rehabilitation, such as paralysis after a stroke [18]. BCI trains post-stroke patients to connect perception and action through feedback. Due to the cortical plasticity of the human brain, this training can stimulate neural networks to reorganize and reduce severe motor deficits [19]. It has a good development prospect in the future.

![Keywords co-occurrence analysis atlas (2005–2024)](image1)

![Keywords clustering analysis atlas (2005–2024)](image2)
### Top 25 Keywords with the Strongest Citation Bursts

<table>
<thead>
<tr>
<th>Keywords</th>
<th>Year</th>
<th>Strength</th>
<th>Begin</th>
<th>End</th>
<th>2005 - 2024</th>
</tr>
</thead>
<tbody>
<tr>
<td>hemiplegia</td>
<td>2005</td>
<td>10.94</td>
<td>2005</td>
<td>2008</td>
<td></td>
</tr>
<tr>
<td>awareness</td>
<td>2006</td>
<td>6.91</td>
<td>2006</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>upper extremity function</td>
<td>2008</td>
<td>7.01</td>
<td>2008</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>randomized controlled trial</td>
<td>2007</td>
<td>14.06</td>
<td>2010</td>
<td>2018</td>
<td></td>
</tr>
<tr>
<td>botulinum toxin</td>
<td>2006</td>
<td>6.93</td>
<td>2010</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>trial</td>
<td>2008</td>
<td>10.47</td>
<td>2012</td>
<td>2017</td>
<td></td>
</tr>
<tr>
<td>adult</td>
<td>2008</td>
<td>9.3</td>
<td>2014</td>
<td>2019</td>
<td></td>
</tr>
<tr>
<td>people</td>
<td>2015</td>
<td>12.76</td>
<td>2015</td>
<td>2020</td>
<td></td>
</tr>
<tr>
<td>individual</td>
<td>2013</td>
<td>8.91</td>
<td>2015</td>
<td>2020</td>
<td></td>
</tr>
<tr>
<td>quality of life</td>
<td>2008</td>
<td>7.02</td>
<td>2015</td>
<td>2019</td>
<td></td>
</tr>
<tr>
<td>pattern</td>
<td>2015</td>
<td>6.82</td>
<td>2015</td>
<td>2018</td>
<td></td>
</tr>
<tr>
<td>speed</td>
<td>2011</td>
<td>6.81</td>
<td>2015</td>
<td>2019</td>
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<tr>
<td>outcome</td>
<td>2018</td>
<td>7.14</td>
<td>2018</td>
<td>2022</td>
<td></td>
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<tr>
<td>management</td>
<td>2009</td>
<td>7.87</td>
<td>2019</td>
<td>2024</td>
<td></td>
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<tr>
<td>shoulder pain</td>
<td>2013</td>
<td>6.74</td>
<td>2019</td>
<td>2020</td>
<td></td>
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<tr>
<td>validity</td>
<td>2011</td>
<td>6.56</td>
<td>2019</td>
<td>2021</td>
<td></td>
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<tr>
<td>acute ischemic stroke</td>
<td>2016</td>
<td>11.83</td>
<td>2020</td>
<td>2024</td>
<td></td>
</tr>
<tr>
<td>case report</td>
<td>2020</td>
<td>10.21</td>
<td>2020</td>
<td>2024</td>
<td></td>
</tr>
<tr>
<td>cerebral infarction</td>
<td>2005</td>
<td>8.37</td>
<td>2020</td>
<td>2021</td>
<td></td>
</tr>
<tr>
<td>ischemic stroke</td>
<td>2008</td>
<td>17.22</td>
<td>2021</td>
<td>2024</td>
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<td>risk</td>
<td>2014</td>
<td>10.53</td>
<td>2021</td>
<td>2024</td>
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<tr>
<td>motor function</td>
<td>2018</td>
<td>8.24</td>
<td>2021</td>
<td>2024</td>
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<td>mechanical thrombectomy</td>
<td>2021</td>
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<td>mirror therapy</td>
<td>2021</td>
<td>6.47</td>
<td>2021</td>
<td>2022</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 7 Keywords emergence analysis chart (2005–2024)**

**Figure 8 Keywords timeline analysis atlas (2005–2024)**

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Analysis of cited articles
Online analysis was conducted on the Web of Science database, and the cited frequencies were sorted in descending order. The article titled "Guidelines for Adult Stroke Rehabilitation and Recovery: A Guide for Healthcare Professionals from the American Heart Association/American Stroke Association" with the highest citation frequency was retrieved, cited 37 times.

Discussion
A total of 2625 articles were included in this study. The visual analysis conducted by CiteSpace on articles published and authors' collaboration revealed that over the past 20 years (2005–2024), a total of 186 authors contributed articles in the field of post-stroke hemiplegia, resulting in a total of 2625 articles published. Among them, the author with the highest number of published articles contributed 16 articles, representing 0.6% of the total number of articles. This suggests that research in the field of post-stroke hemiplegia is still limited, with a low overall number of published articles. From the co-authorship atlas, we can see that Chae, John, Page, Stephen J, Jang, Sung Ho, Fotopoulou, Aikaterini, and Gao, Fan have authored more articles, but they are not closely related to each other. Chae, John, has the most articles. The research direction of the team led by John, Knottson, Jayme S., Harley, and Mary Y. is mainly focused on contralateral functional controlled electrical stimulation, which has positive significance for the recovery of motor function of the upper limb hemiplegia after stroke [20]. Contralateral function control Electrical stimulation can deliver electrical stimulation to paralysed muscles to produce limb movements that are synchronized with the movements of cognate limbs on the opposite side of the body. The real-time patient-controlled intensity of stimulation to the parietal limb, synchronized bilateral symmetric movement, and stimulation-assisted practice of functional tasks that are considered to be important for motor recovery and promoting neuromuscular plasticity [20]. Because the upper limb motor dysfunction is the manifestation of the significant deviation between the nervous system structure and the motion-related structure, the recovery of upper limb function has positive significance for the prognosis of stroke.

The analysis of country afilias showed that China and the USA had the largest number of articles, indicating that stroke research in these countries was more advanced compared to other nations. At the same time, cooperation between the USA and other countries was much higher than that in China, indicating that the USA had made significant investments in this field, resulting in more reliable research outcomes. Based on the analysis from the perspective of the institutions that issued the articles, it is clear that Ohio State Univ, Capital Med Univ, Case Western Reserve Univ have issued the most articles. Capital Med Univ has close ties with other institutions, indicating its significant role in promoting the development of the field of post-stroke hemiplegia.

Keywords are the essence of the research perspective in the article and can encapsulate its core content. Therefore, analyzing the keyword map can more accurately identify the hotspots of post-stroke hemiplegia research and the changes in the cutting-edge fields. Through the analysis of a keyword co-occurrence map, it was found that "stroke," "rehabilitation," "hemiplegia," "recovery," and "reliability" were the most frequently mentioned keywords. It can be seen that the reliability of rehabilitation treatment for post-stroke hemiplegia is currently the most studied field. Therefore, more effective and safer rehabilitation measures are urgently needed and deserve extensive attention. Clustering analysis on keywords revealed that 11 classes were obtained. The Q value and S value of clustering were 0.775 and 0.9125, respectively, indicating that the clustering was significant and the result was reliable. According to the specific gravity, the top three priorities are: #0 rehabilitation, #1 acute ischemic stroke, and #2 motor recovery. Among them, rehabilitation primarily emphasizes the significance of rehabilitating hemiplegia following a stroke. Because the brain is plastic, activating the motor network through passive motion is of great significance for the prognosis of patients. Specific rehabilitation therapies mainly include physical therapy, sensory stimulation therapy, or forced induction therapy [21]. For example, transcutaneous electrical nerve stimulation (TENS) has been proven to enhance hand motor function in patients with chronic hemiplegia [22]. On the other hand, the traditional Bobath method allows patients to actively engage in executive function by utilizing joint compression and stretching, making it suitable for a wide range of post-stroke hemiplegia patients [23]. However, the method advocates avoiding any form of strength training. It is believed that strength training may increase spams that hinder exercise rehabilitation [21]. Brunstrom’s method is based on repetitive training of automatic reflexes, including resistance training [21]. Obviously, there is a contradiction between the two statements. But none of them has proven to be superior. It still needs to be further verified in clinical practice. Acute ischemic stroke is an arterial obstruction that disrupts blood flow to the brain and is the most common cause of hemiplegia among survivors. Therefore, early intervention plays a crucial role in determining the disease outcome. Among them, intravenous thrombolysis and mechanical thrombectomy have proven to be very effective. For example, tissue plasminogen activator (t-PA) can dissolve blood clots that block cerebral arteries and improve the prognosis within the first 4.5 hours after a stroke, thereby preventing complications such as hemiplegia. Mechanical thrombectomy is an intravascular procedure used to remove a blood clot blocking the cerebral artery within the first 24 hours after the onset of a stroke [24]. Motor recovery is closely related to the neural plasticity and cortical reorganization of patients with post-stroke hemiplegia [25]. Some studies have found that exercise can reduce the concentration of IL-1β and TNF-α, it also played an anti-inflammatory role in the central nervous system by reducing the inflammatory response of microglia [26]. In addition, exercise can also regulate miRNAs-21 targeting to block pro-apoptotic protein and PTEN, thereby promoting neuronal regeneration after injury [27]. Changing the inflammation and apoptosis processes after a stroke by inducing cortical reorganization, neural plasticity, angiogenesis, and altering the levels of neurotransmitters in the brain is crucial for promoting motor recovery [28]. Such as early intervention with repetitive target-oriented intensive therapy, appropriate non-invasive brain stimulation (e.g., TENS), and drug therapy (e.g., levodopa) [22, 29, 41].

According to the results of the first 20 keywords with the strongest burst intensity, it can be seen that motor function, Mechanical Thrombus, and mirror therapy embody the treatments for motor function rehabilitation and post-stroke hemiplegia, which are the current research focuses. According to the etymology of the keywords "shoulder pain" and "botulinum toxin," hemiplegic shoulder pain (HSP) is a prevalent complication resulting from muscle weakness, muscle tension alterations, and soft tissue changes around the shoulder joint due to upper motor neuron injury in stroke patients. This condition can impede the rehabilitation outcomes of stroke survivors [30]. At present, the treatment approaches mainly include limb positioning, passive exercise, analgesic drugs, percutaneous electrical nerve stimulation for pain relief, and injection of botulinum toxin type A [31]. Among these, botulinum toxin type A can bind to presynaptic receptors at local motor nerve endings, inhibit acetylcholine secretion, and cause temporary muscle paralysis [32]. The posterior cingulate/anterior cingulate region was found to be strongly associativity with pain sensitivity [33]. Zuzana Senkórová et al. [34] found a relative decrease in activation of the posterior cingulate/anterior cingulate region following botulinum toxin injection. In order to achieve the effects of relieving pain and upper limb joint contracture. However, the exact standard use and dosage specifications of botulinum toxin need to be further studied.

Given the unclear clinical efficacy and usage specifications of botulinum toxin injections, it is imperative to identify alternative therapies. Among these interventions, mirror therapy is an alternative approach to enhance the patient's motor function. Mirror visual feedback can activate the mirror neuron system (MNS) located in the vision-related regions of occipital, temporal, and parietal lobes.
as well as bilateral frontoparietal motor regions. MNS can connect sensory neurons involved in visual processing with motor neurons responsible for action signals, promoting neural remodeling and facilitating the recovery of upper limb motor function [35]. Therefore, the activation of the MNS is crucial for remodeling the primary motor cortex. Some studies have indicated that following mirror therapy treatment, a shift in activation balance towards the affected hemisphere in the primary motor cortex could be observed [36]. At the same time, mirror therapy was also able to weaken the inhibitory effect of the cerebral corpus callosum on neurons and enhance the neuronal activity on the hemispheric side of the patient [37]. Mechanical thrombectomy employs stents and catheters to swiftly eliminate thrombi from large intracranial vessels and restore blood flow. The mechanical thrombectomy technique currently mainly involves the use of a thrombectomy stent combined with an aspiration catheter [38]. At present, large-scale clinical trials have proven that mechanical thrombectomy is effective for treating acute ischemic stroke caused by cerebral infarction [39]. For example, the mechanical thrombectomy of intravascular photoacoustic recanalization can further shorten the recanalization time. At the same time, it can reduce or eliminate the use of fibrinolytic drugs and the risk of symptomatic bleeding, thereby improving the prognosis and reducing the likelihood of post-stroke hemiplegia [40].

The analysis of a timeline atlas of keywords revealed that terms such as intra-cerebral hematology quality, Barthel Index, and Modified Ashworth Scale underscore the significance of assessing disease severity post-stroke to inform treatment decisions. The keywords “brain-computer interface,” “mirror therapy,” “mechanical thrombectomy,” and “ankle-foot orthoses” represent the current prominent approaches for treating hemiplegia after a stroke.

In the literature on hemiplegia after stroke, the most cited article is “Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Health Care Professionals from the American Heart Association/American Stroke Association” [41]. It is pointed out that prognosis of stroke is chronic. This guide elaborates on the prevention, treatment, rehabilitation, and prognosis of stroke. In view of the common complications and sequelae after a stroke, such as deep vein thrombosis, depression, hemiplegia, and shoulder pain, corresponding prevention and treatment measures are proposed. It also suggests that the prognosis management of stroke depends on the involvement of family and community. It establishes comprehensive treatment and nursing guidelines for stroke patients.

Summary

In summary, the articles on post-stroke hemiplegia in the core collection of the Web of Science database were analyzed using CiteSpace. The analysis revealed the current hot spots in gout research, along with the research landscape and collaboration patterns among countries, institutions, and authors, presented through textual descriptions and visual representations. It has been discovered in research that the new surgical method of mechanical thrombectomy is a current focal point in clinical treatment research. Therefore, additional new technologies can be utilized for intravascular thrombectomy. At the same time, rehabilitation measures following a stroke are currently a popular research topic. In the future, better treatment and rehabilitation measures still need to be explored with the help of advancements in medical technology and a deeper understanding of the mechanisms of post-stroke hemiplegia.

References


