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Analysis of the Current Status and Hotspots of Global Research on Subacromial Impingement Syndrome based on the WOS Database

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Abstract: ***Summary: Goal Based on the Core Collection (web of science, WOS) database, CiteSpace software was used to analyze and discuss the current status and hotspots of global research on subacromial impingement syndrome in the past 20 years, which will serve as a reference for future research. Methodologies Relevant research literature on the topic of subacromial impingement syndrome was obtained by searching the WOS database, and after screening and refining the literature data, descriptive statistical analysis was performed on the included literature, and then CiteSpace 6.1 visualization software was used to perform scientometric and visualization analysis of the literature. Conclusion: A total of 1292 papers were included in the analysis, spanning the years 2003-2023. The research literature in the field of subacromial impingement syndrome continues to increase, and although the number of research publications has relatively decreased in the last three years, it is still on an upward trend. There is a lack of collaboration between the authors of the publications. There is strong collaboration between countries, creating an aggregation effect map centered on the United States. Institutions are dominated by university research, with the top three being Hacettepe University, University of Copenhagen, and Commonwealth University. There is a closer collaboration between institutions. Keyword analysis yielded four clusters, and the top keywords were "Subacromial impingement syndrome", "Impingement syndrome", and "Rotator cuff". Conclude Subacromial impingement syndrome is one of the leading causes of shoulder pain and prolonged acromial impingement can also cause rotator cuff tears. The pathogenesis of subacromial impingement syndrome, rotator cuff tears, and shoulder pain interact with each other to complicate shoulder disorders. Therefore, the research on subacromial impingement syndrome should not only reflect the increasing number, but also expand in depth. In addition, subacromial decompression is no longer the primary treatment for subacromial impingement syndrome, and researchers suggest that the advantages of conservative treatment are not weaker than surgical treatment. In the future, with the development and improvement of intelligent rehabilitation systems and personalized medical technology, conservative treatment will receive more attention.***

Keywords: Subacromial impingement syndrome (SIS), Web of Science, Citespace, Research status, A hot research topic**.**

1. Introduction

Subacromial Impingement Syndrome (SIS) is also known as compression syndrome and pain arc syndrome [1]. First proposed by Neer in 1972, it is the most common cause of shoulder pain in adults and is often misdiagnosed as frozen shoulder in clinical practice [2]. When the glenohumeral joint does forward flexion and abduction, due to different reasons, the subacromial space structure is narrowed or the volume of the content increases, and the rostral shoulder arch and the subacromial space are excessively extruded, impinged or even rubbed, resulting in bursitis and soft-tissue injuries, which is a kind of painful disease of the upper limb [3]. The mechanism involves anatomical, kinetic and age-related factors, including impingement of the subacromial tissues on the acromion, repeated abnormal compression of the tissues in the subacromial space, or age-related degeneration and aging of the acromioclavicular joint. Among them, impingement of the subacromial tissues on the acromion, i.e., abnormal acromion morphology, is currently considered to be one of the most important factors leading to this disease. In 1986, Bigliani classified the morphology of the acromion into three types, type I as flat type, type II as arc type, and type III as hook type [4], of which type III hook type acromion is considered to be the most likely to form subacromial impingement syndrome, because the hook type part of the anterior end of the acromion makes the subacromial channel narrow, and the rotator cuff and the subacromial bursa are most likely to be compressed by the acromion, resulting in localized oedema, congestion, and inflammatory changes, resulting in repeated irritation of the subacromial bursa, narrowing of the outlet end of the supraspinatus muscle, and ultimately accelerating the degeneration of the rotator cuff tissue. The rotator cuff and subacromial bursa are most susceptible to compression by the acromion, causing local edema, congestion and inflammation, resulting in repeated irritation of the subacromial bursa, narrowing of the outlet end of the supraspinatus muscle, and ultimately accelerating the degeneration of the rotator cuff tissues, resulting in subacromial impingement syndrome [5]. Currently, elderly patients in our population account for 36.08% of the disease, and foreign epidemiological surveys have found it to account for 40%-70% of all cases of shoulder pain [6-7]. There is no significant difference in incidence between men and women. Subacromial impingement syndrome is more likely to occur in occupations that require repetitive shoulder supination and abduction over a long period of time, such as athletes in swimming, throwing, and weightlifting, construction workers, and painters. These occupations suggest that repetitive over-the-top movements of the upper extremity may be one of the most important factors

contributing to subacromial impingement syndrome.

Research on this disease has continued to increase from 2003 to the present, and is receiving more and more attention from scholars, with different types of research reviews appearing, and the hotspot of research is gradually transitioning from surgical treatment to rehabilitation training, and the necessity of surgery is gradually being questioned by scholars [8]. As research in this area continues to accumulate, it has become necessary to utilize bibliometric methods to systematically and holistically organize the research literature in this area. In this study, we collected global high-quality research literature on subacromial impingement syndrome through the WOS database and used the citespace visualization and analysis software [9], aiming to explore the research and hotspots in this research field and provide a reference for future research.

2. Information and Methodology

2.1 Source of Data

In this study, we used the Web of Science (WOS) database to search for "Subacromial impingement syndrome", and the search period was set from 1 January 2003 to 31 December 2023. 1302 records were retrieved, spanning a period of 20 years, including 1,268 articles in English and 34 articles in non-English. The search results literature was screened and downloaded as a full record with cited references in plain text format.

2.2 Inclusion and Exclusion Criteria

The literature analysed by citespace software was finally included in this study, meeting the following inclusion and exclusion criteria. Inclusion criteria: (1) Literature related to subacromial impingement syndrome, including essays, review papers; (2) Literature included in the WOS database; (3) Literature published in relation to the period 2003-2023. Exclusion criteria: (1) Literature not related to subacromial impingement syndrome; (2) Books, online publication, revisions, etc; (3) Missing title information and duplicate publications.

2.3 Methods of Analysis

Firstly, the analysis function provided by the WOS search platform was used to provide descriptive statistics on the information of the literature, such as published literature, country and so on. The included transcripts were analysed using citespace 6.1.R1 visual analysis software for authors, institutions, countries, keywords, and sic citation literature. Co-occurrence analysis of producers, institutions and countries, co-occurrence analysis, cluster analysis and salient value analysis of keywords. The initial parameters were set consistently across the content analyses, and the content was analysed in depth and eventually mapped to the desired knowledge graph.

3. Conclude

Table 1: Selection of relevant parameters and interpretation of the knowledge map

Parameter type	Parameter selection/icon notation	Analytical reading
Nodal		Nodes are presented in the graph as a chronology, with size representing frequency or amount of published literature, and different coloured rings representing that the content of the node has been published or appeared in different years
Line		When two contents co-occur in a document, a line is generated, with the thickness representing the strength between the two nodes (Cosie's algorithm) and the colour representing time
Sudden Detection		Over the time span of the study, when a piece of content increases in frequency over a consecutive period of time, the year in which it continues to increase is marked in red.
Year Relationship		Relationship between node, link colour and year, different colours of links and nodes in the map represent different years
Time Slice	2year	The included literature was arranged in chronological order of publication and divided into sections with 2 years as a recall slice
Tntermediary Centrality	/	An indicator of the importance of a content in the network, calculated from the lines connecting in and out of the node.

3.1 Annual Trends in Published Literature

The final search yielded a total of 1,292 publications related to the field of subacromial impingement syndrome, all published from 2003-2023, a large time span in which the research literature in the field of subacromial impingement syndrome generally appears to be on the increase, as shown in Table 1. The amount of literature issued in the past years reflects the theoretical level and development rate of subacromial impingement syndrome research, as can be seen from the trend graph, the amount of subacromial impingement syndrome articles gradually increased from 03, and the growth of 17 years remained stable, and reached a maximum value of 108 articles in 2021 after experiencing a period of time at a low level, but the overall trend is upward. The trend of research on subacromial impingement syndrome continued to increase in the time intervals 2003-2010 and 2012-2017, and the growth was especially more pronounced in 2012-2017, with growth rates of 23.6% and 26.05% in these time periods, respectively. It is also observed that the research trend in this field is followed by a 1-2 year break in the number of studies after a few years of sustained growth, in 2011 and 2019, respectively, with a peak in 2021 followed by a gradual decrease in the number of publications on the disease in the last two years. For the discontinuity in the volume of literature in 2011 and 2019, two reasons are considered: first, the research on subacromial impingement has continued to increase in the volume of literature through the phases of 03-10 and 12-17, and when the research has reached a certain depth, it may take more time to digest and organize the existing successes, which in turn will promote the emergence of new research directions and theories. These two years may be the period when research on the disease was in a period of accumulation. Secondly, there is a shift in research hotspots, as the field of medicine continues to deepen, research on other shoulder disorders receives more attention. For example, the number of publications on rotator cuff tears has gradually increased since 2011, and funds or resources in related fields have been allocated more to other research.

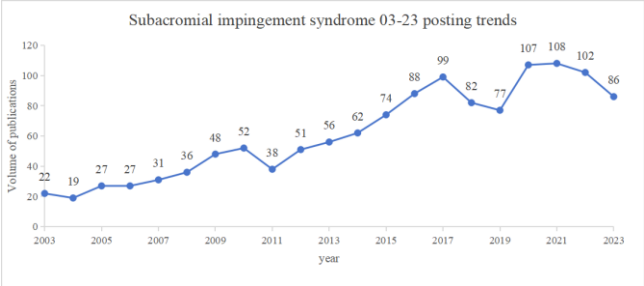

Figure 1: Trends in subacromial impingement syndrome 03-23 postings

3.2 Authors' Analysis

Separate analyses were performed on the issuing authors, for the amount of published literature as well as mediated centrality see Table 2, and the co-occurring knowledge map of the issuing authors is shown in Figure 1. The line between two nodes in Figure 1 represents the existence of collaboration between authors, and the larger the node, the more the number of publications. As shown in Figure 1, the top ten authors in terms of the amount of published literature were: Michener, LoriA(24), Roy, Jean-Sebastien(17), Frost, Poul(12), Cools, Ann(12), Baltaci, Gul(11), Svendsen, Susanne Wulff (10), Kolk, Arjen(9), Ludewig, Paula M(9), Duzgun, Irem(9), Dalboge, Annett(8), The authors with higher publication rankings have more lines of collaboration with others, and there are nodes between the top ten that indicate that there has been collaboration and that the issuing authors collaborated more closely with each other. At the same time, there are a small number of nodes scattered in the periphery of Figure 1, which indicate that the author of the publication only collaborated with one person, or the author alone published the literature. There are also solo groups, such as the green diamond in the lower left corner which shows six people collaborating on a post at the same time. In general, the authors are not closely related to each other. The reasons for the lack of close cooperation between authors may be considered to be the field of study, geographical structure, and lack of cooperative mechanisms.

Table 2: Published Literature by Author

Rankings	Author	Volume Of Published Literature	Intermediary Centrality
1	Michener, Lori A	24	0.04
2	Roy, Jean-Sebastien	17	0.02
3	Cools, Ann	12	0.03
4	Frost, Poul	12	0
5	Baltaci, Gul	11	0
6	Svendsen, Susanne Wulff	10	0
7	Kolk, Arjen	9	0
8	Ludewig, Paula M	9	0
9	Duzgun, Irem	9	0.02
10	Dalboge, Annett	8	0

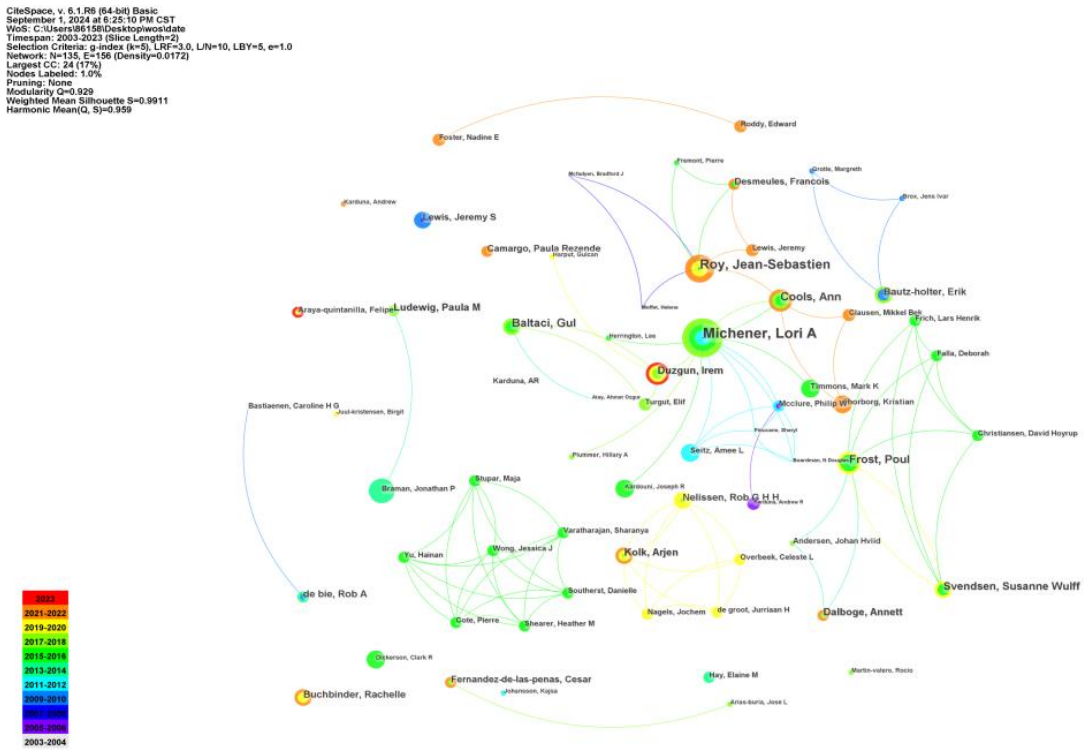

Figure 2: Co-occurrence map of authors of publications

3.3 Keyword Analysis

Taking 2 years as a time slice, all the keywords from 2003-2023 were analyzed, and the keywords with the top 10 frequency of use are shown in Table 3, plotting the keyword co-occurrences (Figure 3), clustering mapping (Figure 4), clustering timeline (Figure 5), and salient values (Figure 6). Figure 3 sees that the keywords involve a total of 137 nodes (N = 137) and 1215 line segments (E = 1215). The line segments represent the connections between keywords, indicating that the keywords are extremely closely related to each other, and the keywords during this period focused on both the disease itself and the symptoms. The study of the disease itself includes the mechanism of its occurrence. In 2013, some scholars, by performing three-dimensional reconstruction of the acromion and clavicle, concluded that the subacromial space of type II and III is smaller compared to that of type I acromion, and that with age and the bone's own degeneration, the subacromial space of type II and III becomes narrower and narrower, resulting in subacromial

impingement. This factor of age also appeared in the later studies of the timeline graphs [10].

Keyword clustering is based on the similarity between keywords grouped into multiple categories of clusters, the larger the serial number, indicating that the cluster contains fewer keywords, and vice versa the smaller the number, indicating that the cluster contains more keywords. The first four clusters include cluster 0: scapula; cluster 1: shoulder pain impingement syndrome; cluster 2: shoulder pain; and cluster 3: rotator cuff. In severe cases, subacromial impingement syndrome can lead to rotator cuff tears, further aggravating the patient's condition. Among the combined rotator cuff tears, supraspinatus tendon tears are the most common. Moreover, the likelihood of rotator cuff tears is not the same for different acromion patterns, with hook acromion combined rotator cuff tears being the most common [11].

The keywords that appear more frequently in the timeline graph are the same as the keyword clusters. From the timeline graph, these keywords are spread out according to the years in which they appeared in the corresponding time period. Between 03-11, the frequency of keyword citations was high, but the keyword expansion was not extensive, focusing on terms such as subacromial impingement and shoulder pain. The appearance of keywords such as age, muscle thickness, and elasticity in recent years shows an increase in the depth and breadth of research on the disease by the issuing authors. In contrast, the frequency of new keywords appearing in subacromial impingement syndrome is less in recent years, suggesting that there are fewer new problems and breakthroughs in this field.

"Highlighted value" refers to keywords with a sudden increase in citation frequency in a certain time period, which is used to analyze and discover research hotspots and academic frontiers. Changes in the prominence of keywords in the study of subacromial impingement syndrome showed three phases: the first phase was from 2003-2012, in which prominence was given to terms such as "rotator cuff" "rotator cuff space" "rotator cuff tear" "rotator cuff impingement" and so on. It is noteworthy that the term "subacromioplasty" appeared in 2010, indicating that surgical treatment of subacromial impingement has become a hot research topic since 2010.However, the question of whether subacromial plasty is the first choice for this disease has been questioned in the last two years, arguing that there is no advantage of surgical treatment over conservative treatment, which offers a better prognosis allowing patients to regain shoulder function sooner [12]. The second phase is 2012-2018, this phase exercise becomes hot. Functional exercises include shoulder pulling training, shoulder balance training, flexibility training and many other ways. These exercises are carried out under the guidance of a professional rehabilitator, which can relieve patients' symptoms, restore their shoulder joint function, and even prevent recurrence. The third stage is 2018-2023, and the treatment modalities of subacromial impingement syndrome have been diversified in the past two years, including general treatment, medication, closed treatment, and surgery. Electroacupuncture and other methods can improve shoulder joint mobility disorders and increase shoulder joint stabilization to relieve local pain [13].

Table 3: Top ten keywords for subacromial impingement syndrome

Rankings	Keywords	Frequency	Highlighting Value	Intermediary Centrality
1	subacromial impingement syndrome	443	-	0.1
2	impingement syndrome	335	9.67	0.16
3	rotator cuff	310	11.09	0.11
4	shoulder pain	238	-	0.07
5	shoulder impingement syndrome	209	-	0.09
6	pain	197	15.41	0.1
7	shoulder	188	15.02	0.04
8	reliability	160	-	0.07
9	rotator cuff tear	136	-	0.12
10	exercise	134	-	0.06

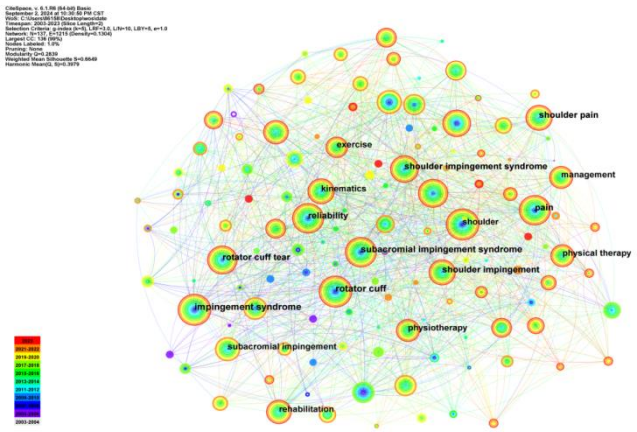

Figure 3: Keyword co-occurrence

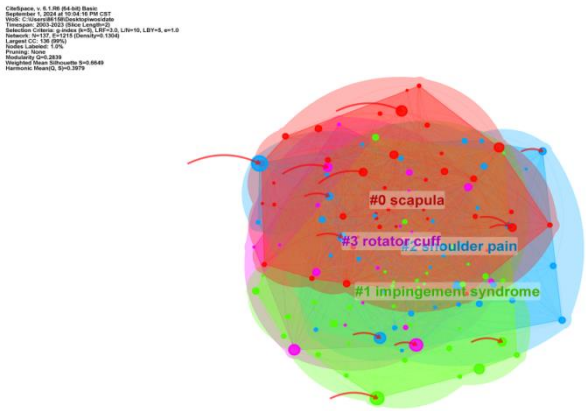

Figure 4: Keyword clustering

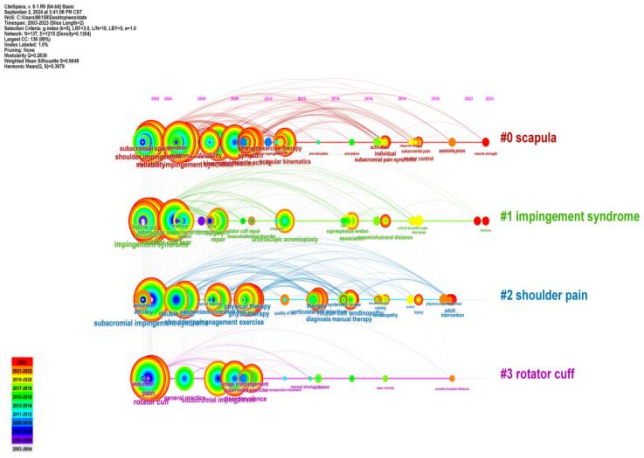

Figure 5: Keyword timeline

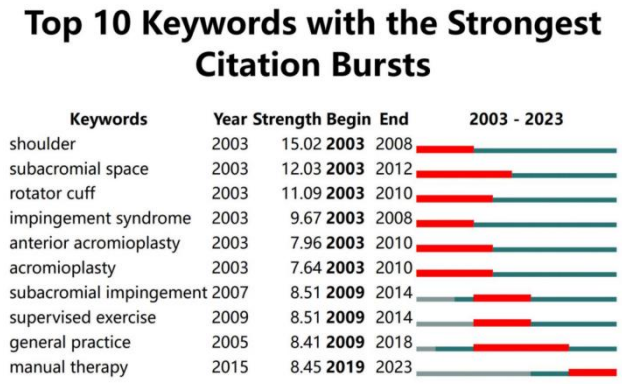

Figure 6: Keyword highlighting values

3.4 Analysis of Issuing Countries

There is a large disparity in the amount of literature published on subacromial impingement syndrome between countries, with the United States leading the field, forming a well-connected visualization led by the U.S. The U.S. produced the greatest number of articles, 337 in 2003, with the U.K. in second place with 127 articles on the subject in that year, and the final third coming from Turkey with 124 articles. The three accounted for 26.08% in the US, 9.82% in the UK and 10.37% in Turkey. The United States, as a major scientific research country, has a great advantage in terms of scientific research investment and expenditure, so the literature output is larger, and the United States belongs to the more developed countries in competitive sports, the research on the pathogenesis of subacromial impingement syndrome may receive more attention, see Table 4.There is not much cooperativeness between countries, and the links are more scattered, only a few countries have links, see Figure 7.

Table 4: National volume of published literature

Rankings	Country	Volume of published literature	Centrality	Percentage (%)
1	USA	337	0.6	26.08
2	ENGLAND	127	0.2	9.82
3	TURKEY	124	0.01	10.37
4	CANADA	74	0.16	5.72
5	SPAIN	72	0.13	5.57
6	NETHERLANDS	71	0.02	5.49
7	DENMARK	69	0.01	5.34
8	AUSTRALIA	61	0.04	4.72
9	BRAZIL	59	0.08	4.56
10	GERMANY	56	0.15	4.33

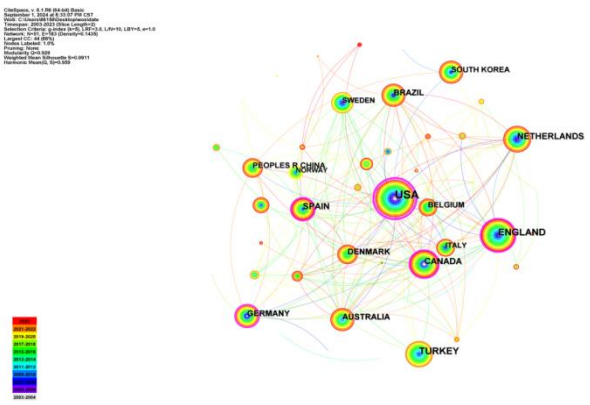

Figure 7: Country co-occurrence map

3.5 Analysis of Issuing Bodies

There is a clear clustering effect of issuing institutions, with the top three institutions being Hacettepe Univ (1.7%), Copenhagen Univ Hosp (1.7%), and Virginia Commonwealth Univ (1.5%), with 22, 21, and 20 articles, respectively. The reasons why the top three institutions in terms of issuance of articles are all from universities may include the following: First, universities, as places for training talents, are more prone to cross-penetration and borrowing of disciplines, thus increasing the amount of articles issued by universities. Second, colleges and universities have rich academic resources and excellent teams of scholars, such as well-known scholars such as leaders, their research results significantly enhance the quality and quantity of the university's issuance. Third, the assessment of teachers and researchers in colleges and universities is paying more and more attention to the quantity and quality of published papers, while the establishment of scientific research projects and funds has provided researchers with research funding and resource support, which further promotes the output of high-level papers. Fourth, the student body's demand for high-level papers has increased significantly. Whether for graduation requirements or for future academic development, students are under pressure to publish high-quality papers, which, to a certain extent, has pushed up the number of papers issued by colleges and universities. There is closer cooperation between institutions, and the output of articles is mostly concentrated in the 2013-2018 period, with more output in 2021-2022 as well. From the previous discounted graph of the trend of articles, it can be known that this period is the research boom of subacromial impingement syndrome, and the number of articles is increasing year by year, so there is close cooperation between countries and institutions in this period.

Table 5: Volume of literature published by institutions

Rankings	Organization	Volume of published literature (articles)	Centrality	Percentage (%)
1	Hacettepe Univ	22	0.06	1.7
2	Copenhagen Univ Hosp	21	0.04	1.6
3	Virginia Commonwealth Univ	20	0.12	1.5
4	Keele Univ	20	0.09	1.5
5	Univ Ghent	19	0.06	1.4
6	Univ Fed Sao Carlos	18	0.12	1.3
7	Aarhus Univ Hosp	18	0.02	1.3
8	Univ Laval	15	0.07	1.1
9	Univ Southern Calif	13	0.13	1.0
10	Arcadia Univ	12	0.01	0.09

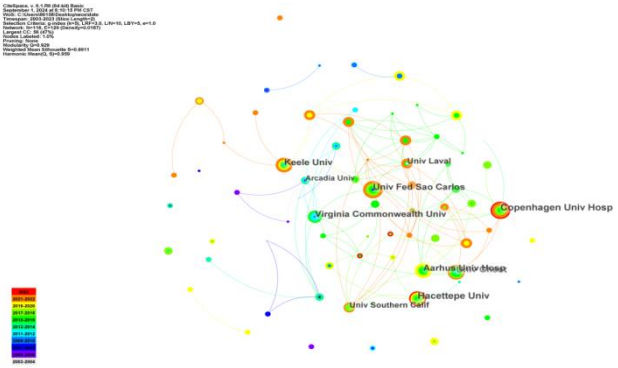

Figure 8: Institutional co-occurrence map

3.6 Total References Cited

Two or more papers are simultaneously corroborated by one or more later papers, and these papers constitute a co-citation relationship with each other. Of all the literature on subacromial impingement syndrome, one of the most cited

comes from a group of randomized surgical controlled trials published by David J Beard in The Lancet in 2018 "Arthroscopic subacromial decompression for subacromial shoulder pain (CSAW): a multicentre, pragmatic, parallel group, placebo-controlled, three-group, randomised surgical trial" [14]. The trial randomized patients with shoulder pain into an arthroscopic decompression group, an arthroscopic examination group, and a no-treatment group. The results showed that the surgical group had better outcomes in terms of shoulder pain and function, but this difference was not clinically important. In addition, surgical decompression did not appear to provide additional benefit over arthroscopy alone. Differences between the surgical and untreated groups may be the result of a placebo effect or postoperative physical therapy. The findings question the value of the procedure for these indications and should be communicated to patients during the shared treatment decision-making process. This literature suggests that as subacromial impingement syndrome has been studied in depth, there is a growing number of studies in which patients are favored for conservative treatment. Considering the certain risks associated with surgery, such as infection, nerve damage, and vascular damage, conservative treatment can avoid these surgical risks and reduce the physical and psychological burden on patients. In addition, in the case of conservative treatment, appropriate functional exercises and rehabilitation training under the guidance of the patient's physician can help the natural recovery of the subacromial tissues and enhance the stability of the shoulder joint. This echoes the term rehabilitation that appeared late in the previous keyword timeline.

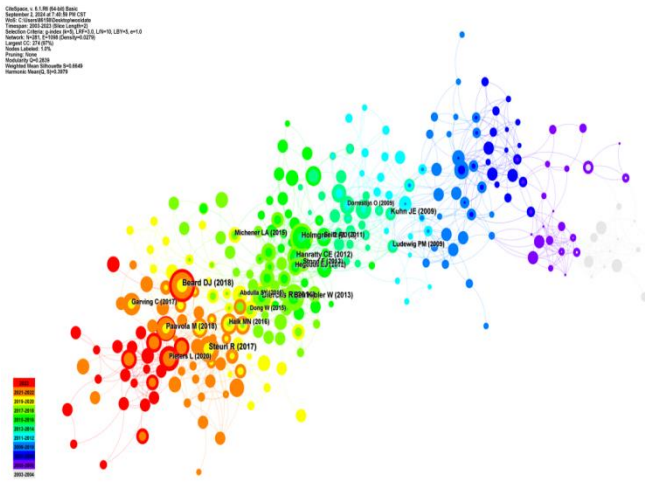

Figure 9: Reference co-occurrence map

4. Discussion

Bibliometrics is a statistical analysis and quantitative tool for the study of publications (dissertations, books, etc.), used to assess information about the relevance of a publication in a particular field to a country, institution, author, etc. The bibliometric work CiteSpace scientific literature visualization and analysis software used in this study, which is widely used in the fields of intelligence, sociology, medicine, etc., is mainly used to excavate the characteristics, laws and hotspots of the research in a certain scientific field by means of data processing and visualization and analysis.

An analysis of 20 years of research on subacromial impingement syndrome found that the research hotspot in this area has been consistently increasing, and the research is of high quality and specialization, but most of the research is published in a small number of high-quality journals, with a relatively high concentration of published literature reflecting a narrower breadth of research and a lack of greater crossover with other areas. There are fewer contacts between authors and lack of communication between them. The research power contrast between different countries and institutions in this field is huge, with large research countries and universities occupying a large proportion of the literature, a phenomenon related to the disparity of scientific research power between countries and the large amount of scientific research resources available in universities. The top 3 countries contributing to this area of research were the United States 26.08%, the United Kingdom 9.82%, and Turkey 10.37%, and the top 3 institutions were Hacettepe Univ (1.7%), Copenhagen Univ Hosp (1.7%), and Virginia Commonwealth Univ (1.5%). The co-occurrence analysis of countries and institutions found that there were fewer links and insufficient cooperation between countries in this area, while there was closer cooperation between institutions. In terms of the keywords used in the articles, from the initial focus on just the disease of subacromial impingement syndrome itself, the articles gradually delved into the mechanisms of the disease, the treatment of the disease, and the rehabilitation of the disease in its later stages.

In the past 20 years, minimally invasive arthroscopic technology has developed rapidly [15]. Subacromial impingement syndrome, often as the first shoulder disease most shoulder and elbow surgeons handle with, and arthroscopic acromioplasty, often as the first surgery most orthopaedic surgeons operate, although it seems to be simple and easy to start, the mechanism of its formation has not yet been completely clarified till now. Therefore, SIS has been a treatment difficulty in the field of orthopedics and a focus of research attention. Some researchers believe that subacromial impingement syndrome is one of the major causes of shoulder pain [16], when the shoulder is elevated or abducted, the greater tuberosity of the humerus repeatedly impinges on the rostral shoulder arch composed of the acromion and the rostral shoulder ligament, resulting in irritation and damage to the subacromial bursa and rotator cuff tissues, which in turn causes shoulder pain. For many years, researchers and clinicians have sought a comprehensive understanding of the anatomical factors that contribute to subacromial impingement syndrome. The impact of Type I, Type II, and Type III acromions on subacromial impingement syndrome varies due to differences in ethnicity and chosen research methods. According to Bigliani et al, hooked acromion, or type III acromion, is most often associated with rotator cuff injury and subacromial impingement syndrome [17]. Secondly, subacromial impingement syndrome is also one of the most important triggers of rotator cuff tears. progressing subacromial impingement can lead to subacromial bursitis, rotator cuff tendon degeneration and calcification, and ultimately a rotator cuff tear. Rotator cuff tears can develop as a result of subacromial impingement, and with increased impingement and damage to the rotator cuff tissues, the rotator cuff may become partially or completely torn, further exacerbating the shoulder pain and limitation of shoulder joint motion [18]. In a clinical study conducted by Zhu Yingchun et

al, it was demonstrated that there is a close relationship between impingement acromion and total supraspinatus tear [19]. Whether it is subacromial impingement syndrome, shoulder pain, or rotator cuff tear, the three do not exist independently, and the development of one can lead to the development and exacerbation of the other. Therefore, research on subacromial impingement syndrome should not be limited to an increase in quantity, but also in the depth and quality of the literature.

In addition, a search of the WOS database revealed that the top 3 research hotspots for subacromial impingement syndrome are: surgical correction, sports medicine, and exercise rehabilitation therapy. Arthroscopic surgery is the preferred surgical modality. Arthroscopic surgery is widely used because of its less invasive, low bleeding and fast recovery [20-21]. Arthroscopic subacromial decompression is an effective treatment for subacromial impingement syndrome, with a success rate of 77%-90% [22]. Several studies have shown that subacromial decompression has a good long-term efficacy in elderly patients compared with conservative treatment, and that after 20 years of follow-up, the vast majority of patients have achieved a satisfactory outcome [23-25]. However, despite half a century of surgical existence and a large number of relevant publications, acromioplasty remains controversial [26-28]. Early to 1993, Brox et al. performed a 6-month follow-up of 125 patients with subacromial impingement syndrome and showed that there was no significant difference in Neer scores of shoulder function between patients treated with arthroscopic subacromial decompression and those treated with functional exercises. The results showed no significant difference in Neer scores between patients treated with arthroscopic subacromial decompression and those treated with functional exercise, and there was no significant advantage of arthroscopic subacromial decompression at 2.5 years of follow-up [29-30]. Lavignac P et al. found by collecting a large number of acromioplasty literature reviews that most acromioplasty studies have poor methodology and lack measurement tools to quantify resections and studies to assess the correlation between clinical outcomes and the number of resections, the author noted that acromioplasty, although widely used, is rarely standardized. Therefore, other approaches may be more worthy of development in the treatment of subacromial impingement syndrome. Furthermore, acromioplasty needs to be performed more precisely, and inadequate or inaccurate removal of bone spurs during surgery may lead to poorer outcomes [31-32]. There is no standard for what degree of acromioplasty is reasonable for the acromion. Clinical experience is that the lateral angle of the acromion and the stopping point of the deltoid muscle on the acromion are determined, and then the overhanging bone below the stopping point of the deltoid muscle is removed, at the same time the rostral acromioclavicular ligament is cut off [33]. If too much of the lateral border of the acromion is removed, it may lead to weakness of the deltoid muscle, which in turn affects the overall function of the shoulder joint.

On top of that, both subacromial decompression and arthroscopic acromioplasty are more expensive than physical therapy in terms of cost, so conservative treatment and rehabilitative physical therapy may become the next hotspot for shoulder impingement syndrome [34]. The rise of conservative treatment is also due to the fact that different patients process nociceptive inputs differently, with some patients presenting preoperatively with radiating pain along the arm or punctate tingling in the skin, which represent central pain sensitivity, and as a result, can lead to a worsening of the patient's prognosis up to 3 months postoperatively [35]. A number of randomized controlled trials have shown that surgical treatment of subacromial impingement syndrome does not have better outcomes compared to conservative outcomes, leading to a change in the treatment of SIS from surgical to conservative treatment. Conservative treatment research is moving in a more nuanced direction, such as guided self-training programs for subacromial syndrome shoulders treated with conventional physical therapy or functional bracing, where guided self-training can produce similar results to conventional physical therapy [36]; For example, Bennett, S et al used sports rehabilitation and manipulative therapy to treat subacromial impingement syndrome in a tennis player to reduce pain, increase limb function, and return to competitive sport [37]. Conservative treatment and rehabilitation of subacromial impingement syndrome are expected to become more individualized and precise in the future. As medical technology continues to advance, future treatments will pay more attention to individual differences in patients, and advanced diagnostic tools, such as MRI and shoulder arthrography, will be used to develop more precise treatment plans for patients. In terms of conservative treatment, oral medication, physical therapy and local injections will be further optimized to reduce side effects and improve efficacy [38-40]. Rehabilitation therapy is more phase-oriented, from the protective phase to the controlled activity phase, gradually increasing the time and intensity of the patient's activities, while combining with manipulative therapy, external aids and other means to improve the patient's mechanical characteristics and improve joint stability [41]. However, there are still some shortcomings in the current treatment, such as conservative treatment is ineffective for some patients and requires surgical treatment; the rehabilitation process is long and requires patients' patience and cooperation. In the future, it is necessary to further optimize the treatment plan to improve the therapeutic effect, shorten the recovery cycle and reduce the burden of patients. At the same time, it is also necessary to strengthen patients' health education and improve their knowledge of the disease and self-management ability.

This study provides a systematic overview of the current status and hotspots of global research on subacromial impingement syndrome based on the WOS database. Regarding subacromial impingement syndrome, the shoulder pain it causes affects people's daily life, and the rotator cuff tear that occurs when it develops further reduces the mobility of the shoulder joint. Increasing people are beginning to recognize this disease and seek professional treatment. Currently, the research in this field mainly focuses on basic-type studies, with fewer clinical studies and randomized controlled trials. More relevant studies should be attempted in the future for the treatment of subacromial impingement syndrome, including (1) Precision medicine: with the continuous progress of medical technology, the diagnosis of subacromial impingement syndrome will be more accurate in the future. By means of gene sequencing and biomarker

detection, the condition and prognosis of patients can be more accurately determined; (2) Individualized treatment: Treatment will be more individualized in the future for the specific conditions of different patients. Doctors will take into account the patient's age, gender, physical condition and other factors to develop the most suitable treatment plan for the patient; (3) Biomechanical research: Biomechanical research will reveal the stress on the shoulder joint under different motion states, providing a scientific basis for the prevention and treatment of subacromial impingement syndrome. For example, the collision between the acromion and the humeral head will be studied by simulating the motion state of the shoulder joint, which will provide reference for the design of the surgical program; (4) Standardization of rehabilitation therapy: With the continuous improvement and innovation of medical equipment, rehabilitation therapy plays a crucial role in the treatment of subacromial impingement syndrome. In the future, rehabilitation therapy will be more standardized and systematic to ensure that patients can have more comprehensive and effective rehabilitation guidance and support after surgery; (5) Optimization of conservative treatment: optimization of conservative treatment in the future [42]. At present, different researchers have their own opinions between subacromial decompression and conservative treatment, with the continuous progress and improvement of technology and medical research, conservative treatment may become the primary choice of subacromial impingement syndrome in the future, for postoperative or did not meet the surgical indications of the patients, in the emphasis on the basis of the individual variability of the patient, there should also be a range of standardization is the sign of the maturity and perfection of conservative treatment.

Project

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