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Bibliometric And Visual Analysis of Video Assisted Thoracoskopic Surgery

Video Destekli Torakoskopik Cerrahi Segmentektominin Bibliyometrik ve Görsel Analizi

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ABSTRACT

Introduction: The video-assisted thoracoscopic surgery (VATS) method has been used in thoracic surgery for the last three decades, and segmentectomy operations performed by VATS have an increasingly broader area of usage including thoracic surgery, oncologic surgery, lung cancer, and metastatic lung tumors. The definition and applicability of VATS segmentectomy are dynamically broadening over time, and the number of published reports in this field is increasing. However, no bibliometric analysis of the segmental anatomy in VATS segmentectomy procedures was encountered.
Objective: In this study, keywords and phrases including "VATS segmentectomy" were searched in the Web of Science (WoS) Core Collection, and the collected data were analyzed using the RStudio and VOSviewer programs.
Method: The analyses focused on the current state of research on VATS segmentectomy, previous studies, recent studies, and expectations for the future.
Results: A total of 693 publications were found. The average number of publications per year was 8.16. The most productive countries were respectively China and the US. The country with the highest number of citations was the US. The two most prominent WoS categories were surgery and the respiratory system. The most involved institution was Tongji University (China).
Conclusion: In the keyword analyses, it was seen that the keywords segmentectomy and lung cancer were frequently used, and there were strong connections between the two. It was seen that the recent trend in research in this field involved video-assisted thoracoscopies and robotic surgery, but strong connections indicating the controversial nature of the outputs of research were identified.

Keyswords: VATS, Segmentectomy, Bibliometrics.

ÖZET

Giriş: Video yardımlı torakoskopik cerrahi (VATS) yöntemi göğüs cerrahisinde son otuz yıldır kullanılmakta olup, VATS ile yapılan segmentektomi ameliyatları göğüs cerrahisi, onkolojik cerrahi, akciğer kanseri ve metastatik akciğeri de kapsayacak şekilde giderek daha geniş bir kullanım alanına sahiptir. VATS segmentektominin tanımı ve uygulanabilirliği zamanla dinamik olarak genişlemekte ve bu alanda yayınlanan raporların sayısı artmaktadır. Ancak VATS segmentektomi işlemlerinde segmental anatominin bibliyometrik analizine rastlanmamıştır.
Amaç: Bu çalışmada Web of Science (WoS) Core Collection'da "VATS segmentektomi"yi içeren anahtar kelimeler ve ifadeler araştırılmış ve toplanan veriler RStudio ve VOSviewer programları kullanılarak analiz edilmiştir.
Yöntem: Analizler, VATS segmentektomi ile ilgili araştırmaların mevcut durumuna, önceki çalışmalara, son çalışmalara ve geleceğe yönelik beklentilere odaklandı.
Bulgular: Toplam 693 yayın bulundu. Yıllık ortalama yayın sayısı 8,16 oldu. En verimli ülkeler sırasıyla Çin ve ABD oldu. En çok atıf alan ülke ise ABD oldu. En öne çıkan iki WoS kategorisi cerrahi ve solunum sistemiydi. En çok katılan kurum Tongji Üniversitesi (Çin) idi.
Sonuç: Anahtar kelime analizlerinde segmentektomi ve akciğer kanseri anahtar kelimelerinin sıklıkla kullanıldığı ve aralarında güçlü bağlantıların olduğu görüldü. Bu alandaki araştırmalarda son dönemdeki eğilimin video yardımlı torakoskopiler ve robotik cerrahi olduğu görülmüş, ancak araştırma çıktılarının tartışmalı niteliğine işaret eden güçlü bağlantılar tespit edilmiştir.

Anahtar Kelimeler: VATS, Segmentektomi, Bibliyometri.

INTRODUCTION

Surgical resection is the best therapeutic option for non-small cell lung cancer in terms of both survival and cure rate. However, some patients may not be able to get intensive surgical treatment even though their lung cancer is operable due to their inadequate cardiopulmonary reserves and related comorbidities. Surgical treatment options are now available to these patient groups with low cardiopulmonary reserve thanks to advancements in postoperative care and increased surgical experience, particularly in

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parenchyma-preserving resections that can be carried out with minimally invasive interventions. Furthermore, new research has been released indicating that sublobar resection may be carried out even in cases where pulmonary capacity is adequate, particularly in individuals with early-stage lung cancer. Following these research efforts, interest in sublobar resections amongst thoracic surgeons has increased significantly (1-3). Although it is stated in the National Comprehensive Cancer Network (NCCN) guideline that sublobar resections are a suitable option for patients with poor lung reserve or who cannot tolerate lobectomy due to comorbidities, patients with pure adenocarcinoma in-situ histology, a ground glass solid ratio greater than 50%, peripheral nodules smaller than 2 cm, and doubling times longer than 400 days are considered as acceptable candidates for this surgical alternative (4).

In their study evaluating the advantages of sublobar resections to the patient, Nomori et al., argued that the real functional benefit occurs in single segment resections, and this advantage is limited in other multiple segmentectomies (5). If all of these evaluations lead to the decision to execute a segmentectomy, then anatomical segmentectomy preserving the relevant segment's artery, vein, and bronchus should be carried out without violating oncological principles. Furthermore, sufficient parenchymal surgical margins, a methodical lymph node sampling protocol, and an intraoperative assessment of the tumor's histological characteristics should all be part of the surgical process.

By examining and comprehending the organization of knowledge, bibliometric analysis sheds light on both developmental and qualitative tendencies. In order to assess the state of lung surgery and related research, the goal of this study was to conduct a thorough analysis of segmentectomy research.

METHOD

The keyword “VATS segmentectomy” was used to reach publications for bibliometric analyses. To prevent changes in the dataset as new publications would be added, the information for the relevant articles was downloaded in May 2024 from the Web of Science Core Collection (WoSCC) database. Research articles and books published in any language and listed on WoSCC were included in the analyses. The search results were saved in “tab delimited file” and BibTex” format (6).

Data Analysis

Analyses in different categories, including bibliometric analysis, general outlook, countries/regions, authors/institutions, journals, documents/references, keywords, and trends, were carried out. The data were visualized using WoS, Biblioshiny (R version 4.4.2; Vienna, Austria; www.r-project.org), and VOSviewer (1.6.20; Leiden, Netherlands) (6,7).

RESULTS

Table 1. Category and count of documents according to WOS

Category	Record Count
Surgery	363
Respiratory System	333
Cardiac-Cardiovascular Systems	200
Oncology	123
Medicine - General Internal	27
Medicine - Research, Experimental	18
Anesthesiology	8
Critical Care Medicine	5
Health Care Sciences, Services	4
Orthopedics	4

In the examinations conducted for the bibliometric data analyses, based on searches made for publications using the keyword “VATS segmentectomy” made between November 1966 and May 2024 included in the WoS database, 693 publications were identified. Among these, 493 were research articles, 1 was a book chapter, 41 were conference manuscripts, and 91 were reviews. Moreover, 1098 Keywords Plus (ID) and 736 Author's Keywords (DE) were identified. The first year of publication according to the WoS database was 1996, and only 2 articles on “VATS segmentectomy” were published in that year. The increasing trend of publications over the years is shown in Figure 1/A. This progress, which started with 2 studies in 1966, reached double-digit yearly numbers in the 2000s, and it continued

to grow by showing a fluctuating curve. The highest number of publications was in 2022, whereas small decreases were seen in 2023 and 2024. The three WoS categories in which the highest numbers of publications were made were the “surgery”, “respiratory system”, and “cardiac-cardiovascular systems” categories, which were followed by oncology, biochemistry, and molecular biology, while the average number of publications per year was 8.16 (Table 1).

Keyword analysis

It is known that keywords can summarize a certain topic addressed by an article, provide a general overview of the publication for the researchers, and are seen as a concentrated outline of the main contents of a research article. In addition to this, keywords have an effective position in the dissemination of scientific research results to the reader in a large-scale and rapid manner. Therefore, keywords with high added value that are extracted from existing publications using bibliometric methods are important in terms of uncovering the significant topics in the scientific field in question and revealing the research hotspots around these topics. The Biblioshiny and VOSviewer programs were used to determine the simultaneous usage instances and frequencies of keywords. In the word cloud created in Biblioshiny where the size of each keyword indicated how frequently it was used, “lobectomy”, “segmentectomy”, and “resection” were found to be frequently used keywords (Figure 1/B). To understand the co-word network of keywords and the relationships among keywords, analyses were performed using the VOSviewer program. As a result of the analyses in VOSviewer, keywords were distributed in 4 clusters colored red, yellow, blue, and green, and the size of each node reflected the usage frequency of the relevant keyword in the literature. Furthermore, the thickness of the tie between two keywords (edge) represented the frequency of the co-occurrence of these two keywords. The most frequently used keywords were identified as “segmentectomy”, “lung cancer”, and “video-assisted thoracoscopic”. The largest node belonged to the keyword “segmentectomy” (blue cluster). Additionally, the keyword “segmentectomy” was determined to be strongly connected to the keyword “lung cancer”, while the keyword “video-assisted thoracoscopic” was strongly connected to the keyword “uniport VATS” (Figure1/C).

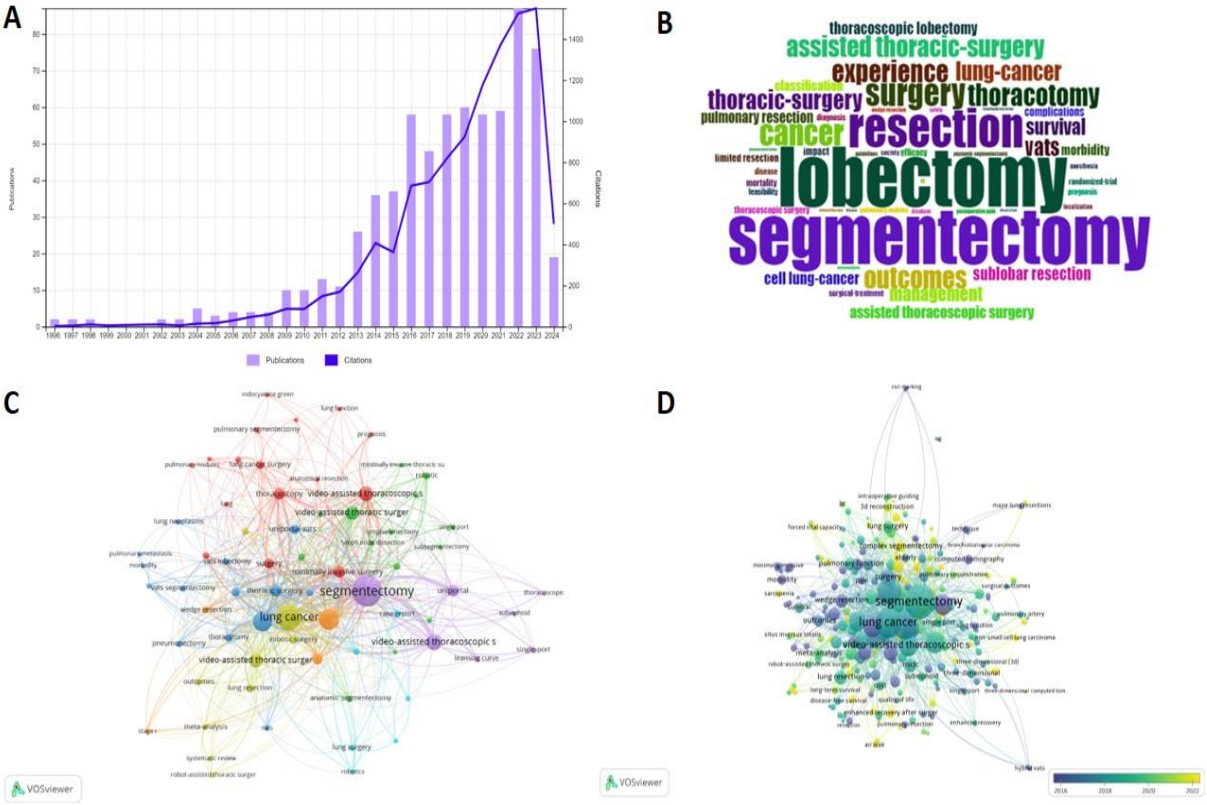

Figure 1/A. The number of documents and citations per year from 1996 to 2024, **Figure 1/B.** Visualized Word-cloud of frequently used keywords in VATS segmentectomy, **Figure 1/C.** Cluster of co-occurrence of keywords, **Figure 1/D.** Trend of keywords by year.

In studies published from 1996 to 2024, the most frequently used terms were “lobectomy” and “segmentectomy”. Here, the color purple represents the keywords that were prevalently used before and in the 2000s, while the color yellow represents those prevalently used from 2020 up to 2024. The keywords “segmentectomy” and “lung cancer” were mainly used in 2016 and before. The terms “video-assisted thoracoscopic" and “single port” were the prominent ones in 2020, while “lung surgery 3D reconstruction” and “3D” were used more frequently after 2020 (Figure 1/D).

Authorship Analysis

The analysis of citation-related data has an important place in bibliometrics. This is an important indicator of the impact of a publication and its research outputs. The impact of a certain author and article can be evaluated based on how frequently the article is cited, by whom it is cited, and the reason for its citation. The sources that are cited the most can also be used to understand the impact of a journal or a group of journals.

The number of authors who had publications with “VATS segmentectomy” as a keyword was 2925 in the examined period, and the number of single-author studies was 26. Each document was cited 15.84 times on average per year.

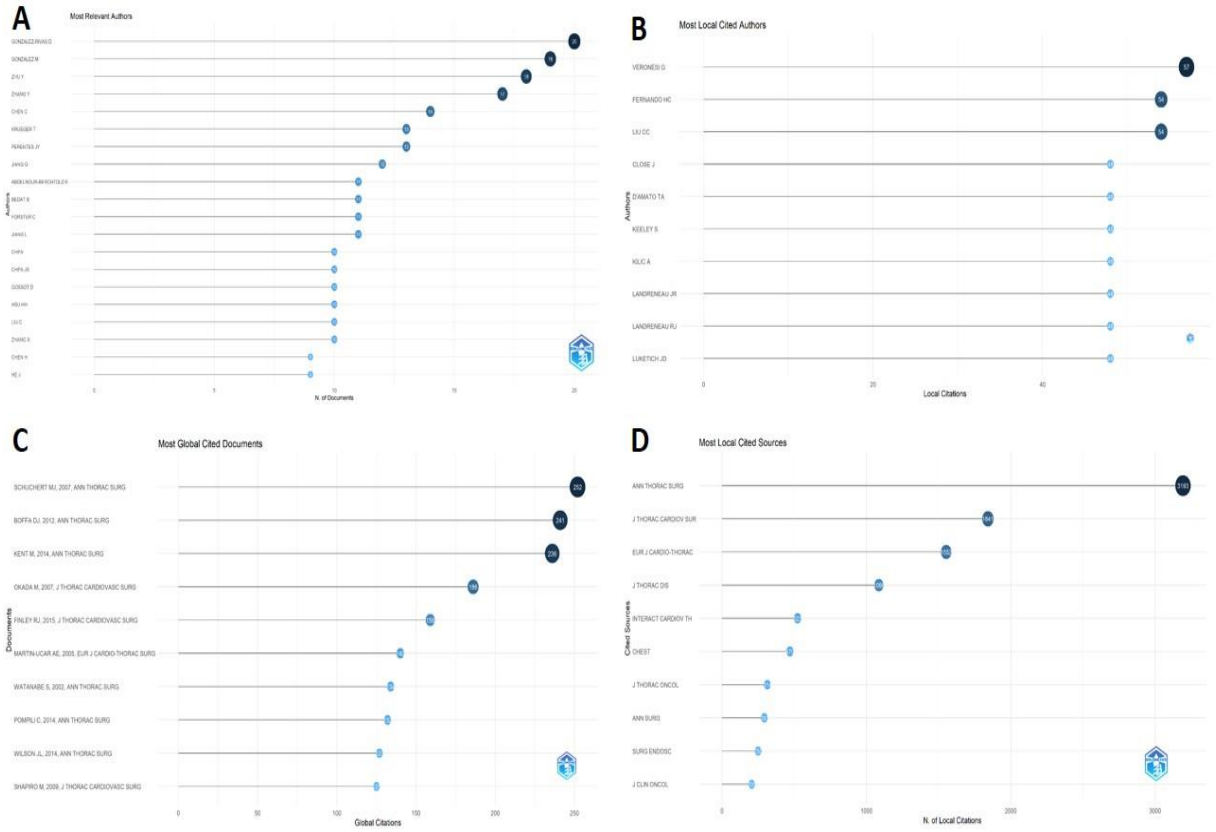

Figure 2/A. Top 20 most relevant authors of VATS segmentectomy, **Fugre2/B**. Top 10 most local cited authors of VATS segmentectomy,**Figure 2/C.** Top 10 most cited documents of VATS segmentectomy,**Figure/D.** Top 10 most local cited sourches of VATS segmentectomy.

The most relevant authors in the examined field are presented in Figure 2/A, the authors who were cited the most frequently about the topic are presented in Figure 2/B, the documents that were cited the most frequently are presented in 2/C, and their platforms of publication are presented in 2/D.

The most relevant author was Gonzalez-Rivas D., followed by Gonzalez M. (Figure 2/A). According to the total frequencies of citations, the most frequently cited author was Veronesi G. (Figure 2/B). The article that was cited the most was the one published by Schuchert M.J. in 2007 (Figure 2/C). The platform of publication that received the highest number of citations was Ann Thorac Surg, and it was followed by J Thorac Cardov Sur (Figure 2/D).

Productivity Analysis

According to the geographical distributions of the examined studies based on the data analyses of their keywords, many of them were found to involve international collaboration despite having different degrees of productivity. The most productive countries in terms of scientific knowledge production and research outputs were China, Japan, and the US. While Japan and the US were the most productive countries in the 2000s, China was in a leading position in 2020. After 2020, the productivity of Denmark and Switzerland in the field increased. In this context, China was found to have close connections with Taiwan, Spain, the UK, and especially the US. The highest numbers of citations were made to studies conducted by authors in the US and China (Figure 3/A). The views of research institutions had a strong impact. In agreement with the global data analysis results, the institution with the highest number of publications was Tongji University, followed by the National Taiwan University Hospital and the National Taiwan University (Figure 3/B). The relationships between the scientific productivity levels of countries and the citations made to studies conducted by authors from these countries (Figure 3/C) represented 4 different steps of analysis.

The publication of research outputs in the countries of the relevant authors was important in terms of explaining the active participation of researchers in research focusing on "VATS segmentectomy". According to their corresponding authors, most of the studies examined here were from China, Japan, and the US. This order did not change in the rankings based on single-country and multi-country publications (Figure 3/D).

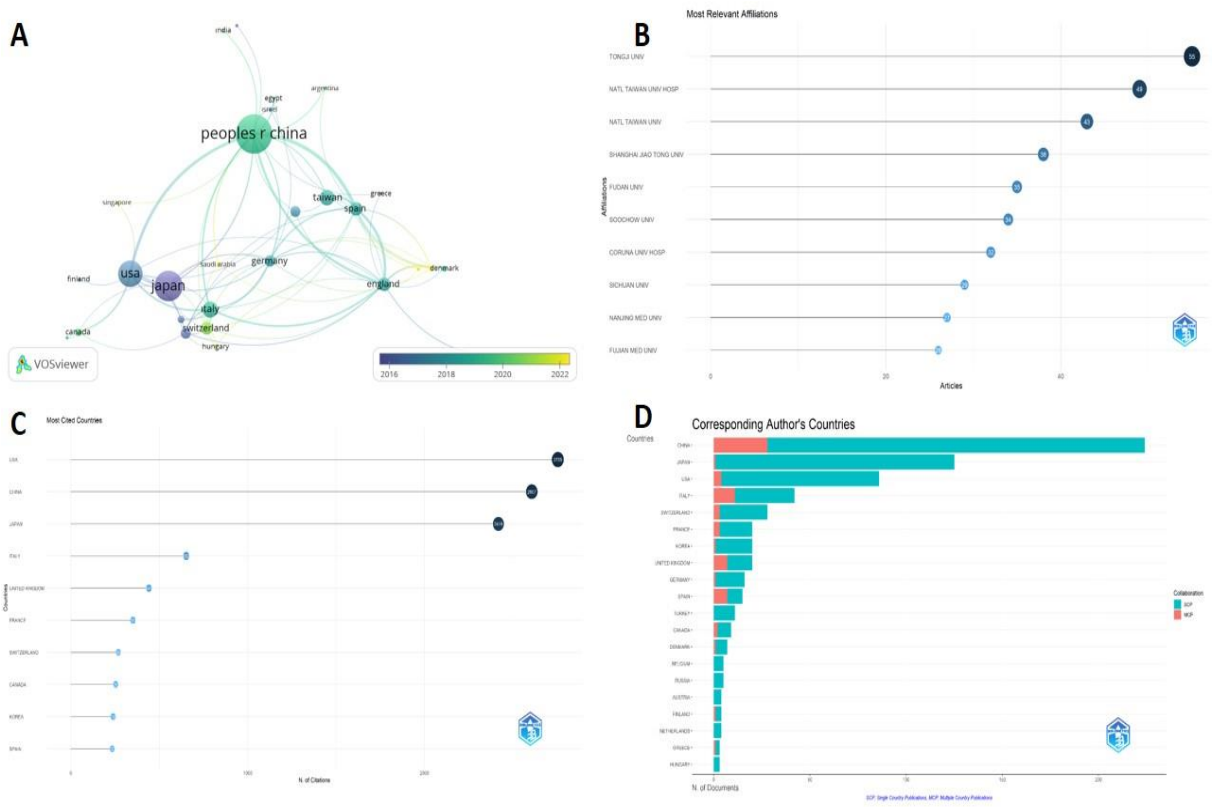

Figure 3: Analysis of national publications in VATS segmentectomy. **A)** Collaboration WorldMap, **B)** Top 10 most relevant affiliation, **C)** Top 10 most cited countries **D)** Corresponding author's countries.

DISCUSSION

Bibliometric studies have an important place in the revelation of developments in a scientific field, the productivity of scientific journals, and the impact of publications. It is known that the bibliometric method has been used in many fields in medical sciences. A bibliometric analysis of the 40 most-cited articles comparing VATS and robotic thoracic surgery in lung cancer cases was reported (8). In addition to this, although bibliometric analyses in the fields of both cancer and segmentectomy are available (9),

no such study on VATS segmentectomy could be found. The adoption of more advanced thoracoscopic surgical techniques in the last 20 years has led to a novel interest in the thoracoscopic approach in thoracic anatomic segmentectomy (VATS). Nevertheless, there is no precise consensus on the indications of VATS segmentectomy, and its role as the definitive treatment of small lesions and early-stage lung cancer is debated. It is also a more complicated procedure in comparison to standard VATS lobectomy, and the need for the surgeon to have experience in this approach is emphasized (10).

Considering the publications in this field in different countries on the continental level, Asia came first, followed by Europe and the Americas. The most productive countries were respectively China, Japan, and the US. China was discovered to have strong connections to the US, Japan, and the UK, while Denmark and Switzerland also joined the race in 2020 onward. The rapid growth of electronics and technology companies in Japan and China in the last 50 years, as well as the reflections of this growth in the field of health, may have been effective in these results (11).

According to WoS data, the first two studies published on this topic in 1996 were a study of experiences of VATS anatomic lung resections in two large hospitals in Hong Kong by Yim et al. in the journal CHEST (12) and a study on the evaluation of respiratory muscle strength following VATS by Nomori et al. in the European Journal of Cardio-Thoracic Surgery (13). The number of publications has gained considerable momentum in the last 30 years, and the highest number of publications in the field was in 2022.

Citation analysis is the most prevalently used bibliometric analysis method that allows the measurement of the impact factor of journals. It was seen that there were 11,093 citations containing the keywords that were used in relation to the topic examined in this study. The highest number of publications was in 2022. The most frequently cited study was the one conducted by Schuchert et al. titled

“Anatomic segmentectomy in the treatment of stage I non-small cell lung cancer”, which was cited 254 times. In the article published in 2007, it was stated that anatomic segmentectomy could be performed with an open approach or the VATS approach safely, and VATS was an advantageous method (14). Additionally, with their studies conducted in recent years, Gonzalez-Ravas D. had very strong authorship connections. The journal that received the highest number of citations was Ann Thorac Surg, with 3193 citations.

Considering the changes in the usage of the keyword “VATS segmentectomy”, it was seen that studies in 2023 focused on “3D reconstruction” and “long-term survival in situs inversus totalis”. In the word cloud created in this study, a strong connection was found between the terms “VATS segmentectomy” and “lung cancer”. The times when these two terms emerged were similar, and the terms associated with these in recent years were “resection”, “lobectomy”, “outcomes”, and “robot-assisted thoracic surgery”.

Despite the increasing popularity of VATS segmentectomy, it is emphasized that its oncological indications in lung cancer cases will remain controversial until long-term outcomes are reported.

In recent times, robotics has been involved in thoracic surgery, and this method was named RATS. While it was seen in our analyses that the RATS approach was not very popular, the number of reports on the surgical outcomes of segmentectomies in this field is increasing. It is observed that researchers are discussing important outcomes of both VATS and RATS such as their short- and long-term benefits and costs (15). In our analyses, there were weak connections between VATS and RATS, and the review of the relevant literature revealed the need to clarify the issue.

CONCLUSION

It was determined that the usage of the term VATS segmentectomy has increased in the last 20 years, the interest in the field has evolved toward hybrid VATS and robotic surgery, the method had advantages, but its outcomes are still a subject of debate.

DESCRIPTIONS

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