



Research article

The top 100 most cited articles on fertility-sparing treatments for cervical cancer: A bibliometric analysis

Xuji Jiang^a, Chuanli Feng^b, Wanying Sun^b, Teng Zhang^{a,*}, Baoxia Cui^a^a Department of Obstetrics and Gynecology, Qilu Hospital of Shandong University, No.107 Wenhua West Road, Jinan City, 250012, Shandong Province, China^b Cheeloo College of Medicine, Shandong University, No.44 Wenhua West Road, Jinan City, 250012, Shandong Province, China

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ABSTRACT

Background: The primary objective of this paper was to assess and analyze the top 100 most cited articles currently cited in studies of fertility-sparing treatments for cervical cancer.

Methods: Searching the Web of Science Core Collection database for the top 100 most cited articles on fertility-sparing treatments for cervical cancer, different aspects of the articles were analyzed, including countries, journals, institutions, authors, keywords and topics.

Results: The search was conducted up to August 2023, and the number of citations for the top 100 articles ranged from 19 to 212. These articles originated from 28 different countries, with Professor Plante, M. from Canada and Professor Sonoda, Y. from the USA having the highest number of articles, both with 10. Professor Plante, M. was the first author of 9 articles and corresponding author of 9 articles. *The Memorial Sloan Kettering Cancer Center* in the USA published the most articles (21) and received a total of 258 citations. *Gynecologic Oncology* published 37 of the top 100 articles, with 524 citations and an average of 14.16 citations per article.

Conclusions: The study concludes that the USA has made the most significant contributions to this field based on the number of articles, authors, and institutions. Additionally, keyword clustering and burst analysis revealed the research hotspots and future trends in this area.

1. Introduction

Recent data show that cervical cancer is the fourth largest malignant tumour in women worldwide, and the age of onset is significantly lower than that of other malignancies. Advances in screening and diagnostic techniques and the increased need to delay fertility have led to a gradual decline in the age of cervical cancer patients. Therefore, the fertility-sparing treatments (FSTs) for cervical cancer have been extensively studied to meet the fertility needs of these patients. Since vaginal radical trachelectomy (VRT) was proposed in 1994 [1], various improved related surgical modalities and more conservative treatment modalities such as trans-abdominal approach, minimally invasive and more conservative surgical modalities, and non-surgical modalities have emerged. Many articles related to the field have been published and have increased our understanding of the field. However, existing research in this area has a different focus and lacks a comprehensive and visual analysis of developments and trends in the field. Therefore, we aim to quantitatively analyze the most popular articles in this field for the first time.

Bibliometrics is a sophisticated tool that uses mathematical and statistical techniques to comprehensively explore published articles

* Corresponding author.

E-mail address: terrie2022@163.com (T. Zhang).

in a given field of study [2]. This method has been widely used in various research fields, such as orthopaedic surgery, cardiac surgery, neurosurgery, etc. This paper aims to quantify the most cited articles on FSTs for cervical cancer for the first time, and analyze their research focus and characteristics, to promote a deeper and more comprehensive understanding of this field.

2. Methods

This study used the Web of Science Core Collection (WOSCC) database for bibliometric analysis. We retrieved data from WoSCC (SCI-E and SSCI) on August 28, 2023. In alignment with the predefined search protocol, the inquiry was executed with restrictions to English-language literature, encompassing solely primary research articles and review publications. The temporal constraints were set to the date of retrieval. Following the exclusion of documents not centrally focused on FSTs for cervical cancer, a curated collection of 526 pertinent references was ascertained. The process of literature filtration was summarized in Fig. 1. Articles ranked according to the number of citations after artificial screening of research topics other than FSTs for cervical cancer yielded the top 100 most cited articles (T100 articles) (Table S1). We collected and analyzed the following information: authorship, journal, year of publication, country, total citations, citation density and topics. Data analysis is performed using CiteSpace (version 6.2.R4), Microsoft Office (2021), VOSviewer (version 1.6.19), the R-bibliometric software package and the online analytics platform (<https://bibliometric.com/>).

3. Results

Publications related to FSTs for cervical cancer for the T100 articles were identified in the WoSCC, of which 80 (79.20 %) were indexed as "articles" and 21 (20.80 %) as "reviews" (Fig. 2a). As shown in Fig. 2b, the T100 articles were mainly published between 2003 and 2020. The T100 articles were cited 6326 times in total, with an average of 62.63 citations. The first two papers, published in 2003 in the *American Journal of Obstetrics And Gynecology* and *Gynecologic Oncology*, evaluated oncological outcomes and pregnancy outcomes in 10 and 21 cervical cancer patients who underwent VRT and pelvic lymph node dissection (PLND), respectively. They proved this surgical method was a viable method for those patients with fertility needs. The most cited article was "Vaginal radical trachelectomy: an oncologically safe fertility-preserving surgery." An updated series of 72 cases and a review of the literature, published in *Gynecologic Oncology* by Professor Marie Plante in 2014, retrospectively analyzed the tumour safety of VRT with a relatively large cohort. The most recent article, a systematic review, published in 2020, described oncological outcomes and pregnancy outcomes for FSTs for cervical cancer and found that VRT had more satisfactory pregnancy outcomes, with transabdominal surgery and minimally invasive surgery having the same oncological outcomes.

3.1. Analysis of the country

A total of 28 countries worldwide participated in the study of the T100 articles on FSTs for cervical cancer. When analyzing the T100 most cited publications, we observed that the USA remained at the top of the list, and was closely followed by the UK, Canada,

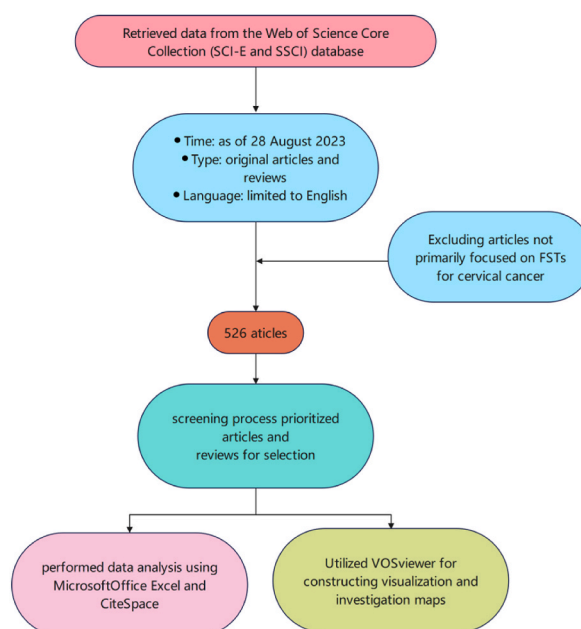


Fig. 1. Flowchart of data filtration processing.

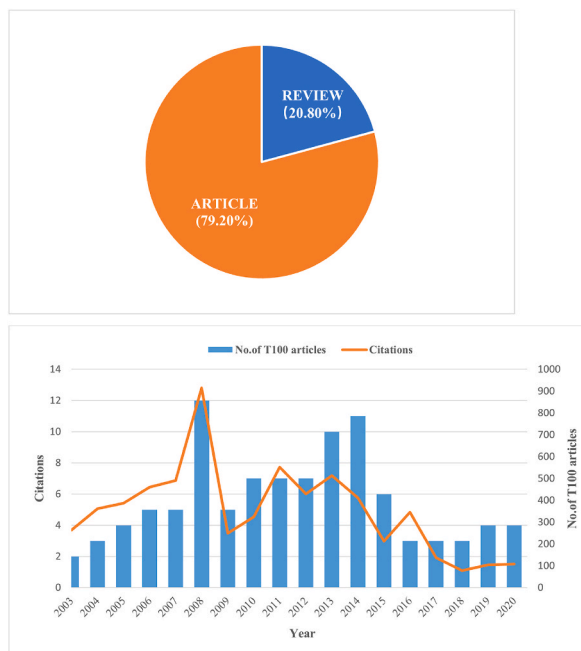


Fig. 2. 2a. Types of the T100 articles published from 2003 to 2020. 2b. Numbers of the T100 articles published from 2003 to 2020.

and Germany (Fig. S1). Fig. S2 illustrated the partnership between countries. Table 1 presents countries that have contributed at least three articles in the T100 articles. The USA contributed the most to the field, with 33 articles published with 2130 citations and an average of 64.55 citations. The UK ranked second with 14 articles published with 813 citations and an average of 58.07 citations. It was followed by Canada (13 publications, 1141 citations, an average of 87.77 citations) and Germany (10 publications, 5592 citations, an average of 59.20 citations).

3.2. Analysis of authors

A total of 499 authors worldwide participated in the preparation of the T100 articles. Table 2 shows authors who have published at least five articles. Among the T100 articles, two professors, *Plante, M.* and *Sonoda, Y.* participated in the largest number of papers, each with 10. Among them, Professor *Plante, M.* has published a total of 9 articles as the first author and 9 as the corresponding author, with a total of 132 citations, and an average of 13.20 citations. Professor *Sonoda, Y.* has published 2 articles as the first author and 3 as the corresponding author, with a total of 119 citations, with an average of 11.90 citations. Professor *Kohler, C* (9 publications, not as first author or corresponding author) and Professor *Abu-Rustum, NR* (9 publications, 2 first authors, 6 corresponding authors) followed. Notably, six of the top 15 contributors are from the USA, and five of them are from *Memorial Sloan-Kettering Cancer Center*. Furthermore, there are 4 authors from *Charité – Universitätsmedizin Berlin*, Germany.

Table 1
Countries for the T100 articles on FSTs for cervical cancer.

| Country | Articles | Citations | Average citations |
|----------------|----------|-----------|-------------------|
| USA | 33 | 2130 | 64.55 |
| ENGLAND | 14 | 813 | 58.07 |
| CANADA | 13 | 1141 | 87.77 |
| GERMANY | 10 | 592 | 59.20 |
| CZECH REPUBLIC | 8 | 534 | 66.75 |
| CHINA | 8 | 303 | 37.88 |
| FRANCE | 6 | 659 | 109.83 |
| ITALY | 6 | 312 | 52.00 |
| JAPAN | 5 | 233 | 46.60 |
| COLOMBIA | 4 | 237 | 59.25 |
| SOUTH KOREA | 4 | 177 | 44.25 |
| SPAIN | 4 | 217 | 54.25 |
| BRAZIL | 3 | 133 | 44.33 |
| HUNGARY | 3 | 246 | 82.00 |
| NETHERLANDS | 3 | 102 | 34.00 |
| TURKEY | 3 | 153 | 51.00 |

Table 2
The most published authors of the T100 articles on FSTs for cervical cancer.

| Author | Articles | Authorship | | Institution | Country | Citations | Average citations |
|----------------|----------|--------------|----------------------|---|---------|-----------|-------------------|
| | | First author | Corresponding author | | | | |
| Plante, M | 10 | 9 | 9 | Laval University | Canada | 132 | 13.20 |
| Sonoda, Y | 10 | 2 | 3 | Memorial Sloan-Kettering Cancer Center | USA | 119 | 11.90 |
| Kohler, C | 9 | 0 | 0 | Charité – Universitätsmedizin Berlin | Germany | 101 | 11.22 |
| Abu-Rustum, NR | 9 | 2 | 6 | Memorial Sloan-Kettering Cancer Center | USA | 118 | 13.11 |
| Schneider, A | 8 | 1 | 3 | Charité – Universitätsmedizin Berlin | Germany | 97 | 12.13 |
| Chi, DS | 8 | 0 | 0 | Memorial Sloan-Kettering Cancer Center | USA | 114 | 14.25 |
| Ramirez, PT | 8 | 0 | 5 | The University of Texas MD Anderson Cancer Center | USA | 52 | 6.50 |
| Shepherd, JH | 7 | 3 | 2 | Barts And The London School Of Medicine And Dentistry | UK | 65 | 9.29 |
| Barakat, RR | 7 | 0 | 0 | Memorial Sloan-Kettering Cancer Center | USA | 100 | 14.29 |
| Speiser, D | 6 | 2 | 1 | Charité – Universitätsmedizin Berlin | Germany | 54 | 9.00 |
| Mangler, M | 6 | 1 | 1 | Charité – Universitätsmedizin Berlin | Germany | 54 | 9.00 |
| Renaud, MC | 5 | 0 | 0 | Laval University | Canada | 103 | 20.60 |
| Roy, M | 5 | 0 | 0 | Laval University | Canada | 102 | 20.40 |
| Cibula, D | 5 | 3 | 3 | Memorial Sloan-Kettering Cancer Center | USA | 51 | 10.20 |
| Wu, XH | 5 | 0 | 4 | Fudan University | China | 15 | 3.00 |

3.3. Analysis of institutions

A total of 152 institutions contributed to the T100 articles, and 10 institutions contributed more than 5 articles, as shown in Table 3. Of the 10 largest publications, the USA accounted for four, China, the Czech Republic, Canada, Germany, the Netherlands and France each contributed one. *Memorial Sloan Kettering Cancer Center* contributed the most of all organizations, publishing 21 articles with 258 citations and an average of 12.29 citations. *Charles University in Prague* from the Czech Republic (12 articles, 124 citations, average citations 10.33) and *Fudan University* from China (12 articles, 42 citations, average citations 10.33) followed.

3.4. Analysis of journals

The T100 articles are from 32 journals, and Table 4 lists journals that publish no less than 2 articles. Of these, most articles were published in *Gynecologic Oncology*, with 37 publications and 524 citations. This was followed by the *International Journal of Gynecological Cancer* (23 publications, 179 citations) and the *Bjog-An International Journal of Obstetrics And Gynaecology* (4 publications, 82 citations).

3.5. Analysis of keywords

After merging synonyms and deleting meaningless words, set the minimum occurrence frequency to 3 in Vosviewer, a total of 15 keywords. Density visualization is shown in Fig. S3. Fig. 3a shows the keyword clustering, with 15 keywords divided into two clusters. Cluster 1 (red) includes 8 keywords: “cervical cancer”, “conization”, “fertility-sparing”, “laparoscopic pelvic lymphadenectomy”, “neoadjuvant chemotherapy”, “pregnancy outcomes”, “simple trachelectomy” and “vaginal radical trachelectomy”. Cluster 2 (green) includes 7 keywords: “abdominal radical trachelectomy”, “hysterectomy”, “laparoscopic radical trachelectomy”, “pathological outcomes”, “pelvic radiation-therapy”, “radical trachelectomy” and “recurrence risk”. Fig. 3b visualizes the average year of occurrence of keywords, such as “conization”, “pathological outcomes” and “pelvic radiation-therapy”, which have emerged in recent years.

Table 3
Top publishing institution of the T100 articles on FSTs for cervical cancer.

| Institution | Country | Articles | Citations | Average citations |
|---------------------------------|----------------|----------|-----------|-------------------|
| Mem Sloan Kettering Canc Ctr | USA | 21 | 258 | 12.29 |
| Charles Univ Prague | Czech Republic | 12 | 124 | 10.33 |
| Fudan Univ | China | 12 | 42 | 3.5 |
| Univ Laval | Canada | 11 | 169 | 15.36 |
| Charite | Germany | 10 | 80 | 8 |
| Univ Texas MD Anderson Canc Ctr | USA | 9 | 54 | 6 |
| Columbia Univ Coll Phys & Surg | USA | 6 | 11 | 1.83 |
| Univ Southern Calif | USA | 6 | 4 | 0.67 |
| Gustave Roussy | France | 5 | 28 | 5.6 |
| Leiden Univ | Holland | 5 | 7 | 1.4 |

Table 4
Journal distribution of the T100 articles on FSTs for cervical cancer.

| Journal | Articles | IF ^a in 2022 | 5-Year's IF | Citations | Average Citations |
|---|----------|-------------------------|-------------|-----------|-------------------|
| Gynecologic Oncology | 37 | 4.70 | 4.90 | 524 | 14.16 |
| International Journal Of Gynecological Cancer | 23 | 4.80 | 3.35 | 179 | 7.78 |
| Bjog-An International Journal Of Obstetrics And Gynaecology | 4 | 5.80 | 5.90 | 82 | 20.50 |
| Journal Of Minimally Invasive Gynecology | 3 | 4.10 | 3.61 | 24 | 8.00 |
| Fertility And Sterility | 3 | 6.70 | 6.65 | 12 | 4.00 |
| American Journal Of Obstetrics And Gynecology | 2 | 9.80 | 8.27 | 44 | 22.00 |
| Best Practice & Research Clinical Obstetrics & Gynaecology | 2 | 5.50 | 4.44 | 6 | 3.00 |
| Obstetrics And Gynecology | 2 | 7.20 | 6.59 | 4 | 2.00 |
| Journal Of Gynecologic Oncology | 2 | 3.90 | 3.86 | 4 | 2.00 |

^a IF:Impact Factor.

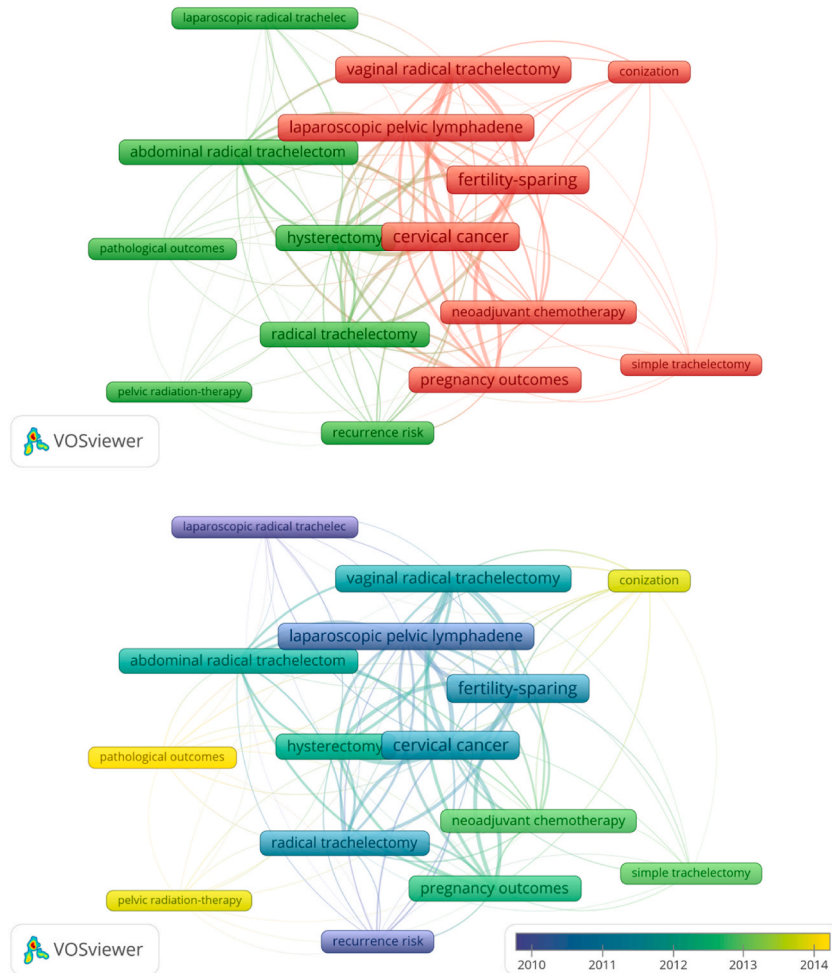


Fig. 3. 3a. Network visualization map of co-occurring keywords created by VOSviewer (Each node is shown as a frame with a label. Larger frames indicate higher frequency in co-occurrence analyses. Each frame is coloured according to the cluster to which it belongs. The thickness and length of links between nodes represent the strength of the connection and relevance between corresponding nodes.). 3b. Overlay visualization map of co-occurring keywords (The frames denote different countries/regions, the colour represents the mean year, the area of the frame represents the number of citations in each country or region, the distance indicates the correlation between each country/region, and the thickness of the connecting line indicates the strength of cooperation between co-authors.). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

3.6. Analysis of keyword bursts

The timeline of clustering indicates that “neoadjuvant chemotherapy”, “cervical carcinoma”, “fertility-sparing”, “early-stage cervical cancer”, “management”, “laparoscopic radical trachelectomy”, and “vaginal radical trachelectomy” are the most important areas of FSTs for cervical cancer (Fig. S4). Fig. S5 illustrates CiteSpace’s application in identifying keyword bursts that set the boundaries for new research avenues in the field. Our attention was drawn to the emerging keywords that emerged in the last five years, including “outcome” (burst strength of 1.84), “risk” (burst strength of 1.58), and “fertility sparing surgery” (burst strength of 1.41), which had continued to this day.

3.7. Analysis of related fields

According to Fig. S6, the T100 articles are mainly concentrated on medical and clinical research. It is worth mentioning that molecular biology and immunology also have a certain impact on the development trajectory of this research field. Therefore, we need to consider the FSTs for cervical cancer in all aspects in the future.

4. Discussion

To our knowledge, this is the first bibliographic analysis of FSTs for cervical cancer. We analyzed the most influential T100 articles in the field. The USA was the country that contributed the most to the field. *Plante, M.* and *Sonoda, Y.* were the most prolific authors, and *Memorial Sloan Kettering Cancer Center* contributed the most of all institutions. Most of the articles were published in *Gynecologic Oncology*.

The results of the USA research on FSTs for cervical cancer were remarkable, which might be related to economic and technological developments. From the point of view of authors and institutions, our analysis of the country was correct. It is worth noting that of the two most published authors, one is from the USA and the other is from Canada. Professor *Plante, M.* from Canada, whose research focused on assessing the safety and efficacy of transvaginal surgery, has made significant contributions to this field and has published several important retrospective studies and reviews [3–12]. Professors *Sonoda, Y.* and *Abu-Rustum, NR* from the same team, have made extensive and significant contributions to FSTs for cervical cancer, highlighting the feasibility of radical trachelectomy (RT) by comparing the safety of radical hysterectomy (RH) and RT, as well as assessing survival and pregnancy rates after different trachelectomy [13–21].

Keyword cluster analysis divides keywords into two clusters. Cluster 1 (red): Dargent pioneered VRT in 1994, and after a series of retrospective studies, it had been proved that VRT combined with PLND is a viable option for young patients with cervical cancer who have fertility needs [3,4]. In a systematic review [22], the author compared VRT and RH in terms of tumour safety, demonstrating no clear difference between the two surgical modalities. Compared with other surgical methods, VRT has the lowest mortality rate of 1.7 % and the best prognosis [23]. In addition, multiple retrospective studies have shown satisfactory pregnancy outcomes after VRT [4,7]. However, VRT has proven unsuitable for patients with tumours larger than 2 cm in diameter due to its high risk of recurrence. A review [24] published in 2016 showed that patients with tumours >2 cm in diameter had a postoperative recurrence rate of up to 17 %. It is worth noting that data reporting varies in transvaginal surgery, probably due to the differing experience of gynecologic oncologists. PLND is an important part of gynaecological tumour surgery. Node-negative determination before or during surgery is required to guide clinical decisions about FSTs. There are several ways to assess lymph nodes, including imaging techniques or intraoperative cryosection pathology by lymphadenectomy. Sentinel lymph node biopsy (SLNB) is currently widely studied and used in clinical practice. Sentinel lymph nodes (SLNs) are the first lymph nodes in which cancer cells spread from the primary site of the tumour to other places. If SLNs are positive, a more comprehensive PLND may be required. However, in SLNs-negative patients, only the first draining lymph nodes rather than all pelvic lymph nodes can be removed. Based on a systematic review of 67 studies, SLNB has an overall detection rate of 89.2 % and an overall sensitivity of 90 %, demonstrating the clinical usefulness of SLNB [25]. In accordance with the updated guidelines set forth by the ESGO/ESTRO/ESP for the year 2023, it is strongly recommended to perform SLNB and its ultrastaging. Should the sentinel lymph node not be identified intraoperatively, a systematic lymphadenectomy should be conducted [26]. However, in patients with tumours ≥ 2 cm in diameter, detection rate and sensitivity decrease, which may be related to lymph node involvement and lymphovascular invasion impeding lymphatic return. In recent years, conization or simple trachelectomy has been a more conservative surgical method than RT because it can avoid the removal of para-uterine tissue and reduce serious post-operative complications without reducing survival and pregnancy rates [27–31]. In a population-based analysis [32], conization combined with lymph node assessment, particularly SLNB, is gradually increasing and is indicated for patients with early-stage cervical cancer who wish to have children in the future. NCCN guidelines recommend that conization or simple trachelectomy be considered in patients with stage IA, depending on lymph node status. According to the literature [23,33], this more conservative surgical approach has a satisfactory pregnancy outcome with a low risk of recurrence (approximately 4.2 %), with a pregnancy rate of 55.1 % and a live birth rate of 71 %. In a recent study [34], 91 patients achieved satisfactory pregnancy outcomes (pregnancy rate 82.9 % and delivery rate 76.2 %) after conization or simple trachelectomy. At present, there are still many relevant studies underway to prove from different angles that this more conservative surgical method can benefit patients who want to have children more than RT, and this research hotspot will continue for some time. Another major research hotspot in this area is Neoadjuvant chemotherapy (NACT), especially for patients with larger tumour diameters. Numerous studies [35–39] have demonstrated that NACT combined with conservative surgery can effectively reduce tumour volume and achieve higher survival and pregnancy rates in patients with large tumour diameters (>2 cm). A systematic review [35] published in 2022 showed that patients (stage IB2) with NACT combined with

FSTs had postoperative recurrence and mortality rates of 9.2 % and 4.6 %, respectively. In a recent retrospective study [40], NACT combined with RT was shown to be feasible in patients with tumours >2 cm in diameter and negative lymph nodes, with a postoperative pregnancy rate of 55 %. However, relapse and mortality rates are unsatisfactory. Although the response rate to NACT is as high as 70 % [11], however, the criteria for selecting appropriate conservative surgical modalities after NACT have not been harmonized. One study [41] showed that NACT in combination with VRT and extraperitoneal PLND was feasible in patients with tumour size ≥ 2 cm (stage IB2-IIA), which had a better prognosis than other RT modalities. Another study [42] also showed that NACT combined with abdominal radical trachelectomy (ART) had the best fertility outcomes. Furthermore, Marchetti et al. conducted a meta-analysis that systematically evaluated the efficacy and toxicity of NACT combined with surgery versus radiochemotherapy in the treatment of locally advanced cervical cancer. The study compared the clinical outcomes and the frequency of severe toxicity between the two therapeutic approaches. The results indicated that, in terms of overall survival (OS), the combination of NACT and surgery did not show a significant improvement (hazard ratio [HR] = 1.08), but there was a significant increase in the risk of recurrence (HR = 1.32), coupled with a higher incidence of severe acute toxicity [43]. Therefore, the use of NACT in combination with conservative surgery can be seen as a feasible and promising approach, but further validation and optimal clinical protocols need to be found in clinical trials.

Cluster 2 (green): The limited clinical application of VRT may be due to the inexperience of most gynecologic oncologists who perform surgery via the vaginal route, so the abdominal approach similar to RH has become a technique more readily available to surgeons trained in RH. In patients with a tumour diameter ≥ 2 cm, transabdominal surgery has been shown to have better tumour outcomes than vaginal or laparoscopic surgery [44]. In addition, ART also resolves the difficulties of vaginal surgery in some prepubertal patients. Proven by research transabdominal surgery has tumour survival rates comparable to RH, and postoperative pregnancy rates are similar to VRT. However, the complication rate after this procedure is high, such as cervical stenosis, increased blood loss and wound infection [45,46]. Minimally invasive radical trachelectomy (MIS-RT), including laparoscopic radical trachelectomy (LRT) and robotic-assisted laparoscopic radical trachelectomy (RRT), has similar oncological outcomes and pregnancy outcomes as VRT and ART, meanwhile avoiding the drawbacks of transabdominal surgery [23,46,47]. One study [48] showed no significant difference in postoperative recurrence and overall survival between open and laparoscopic surgical modalities. However, clinical pregnancy rates were higher in the ART group than in the LRT group. However, lower clinical pregnancy rates in the LRT group may be associated with shorter follow-up times in patients receiving LRT. In addition, the feasibility of RRT has been demonstrated and has similar outcomes to VRT and LRT [47]. However, the safety of MIS-RT remains controversial, especially for patients with tumour diameters ≥ 2 cm. Overall, there is no concrete evidence to support the poorer oncological outcomes of MIS-RT compared with transabdominal surgery, and more research could be conducted to support the feasibility of MIS-RT. In addition, when RT is not the best option for treating cervical cancer, especially in the case of advanced disease, there are novel non-surgical approaches to fertility preservation that can be considered for patients wishing to become pregnant. These options include suppressing ovarian function with gonadotropin-releasing hormone analogues, ovarian transposition, oocyte/embryo cryopreservation and ovarian tissue cryopreservation. However, due to the lack of sufficient study time and large cohort studies, these views are less present in the T100 articles.

Based on a comprehensive analysis of existing research findings, conization or simple trachelectomy was considered as an adequate surgical approach for FSTs in cervical cancer patients at stage carcinoma in situ and IA1 (without LVSI). These procedures not only yield favorable oncological outcomes but also result in satisfactory pregnancy outcomes. For IA1 patients with LVSI, it is recommended to proceed with PLND or SLNB in addition to conization or simple trachelectomy. For patients with stages IA2 to IB1, VRT combined with PLND or SLNB was advocated. In line with the outcomes of the ConCerv trial, patients meeting specific criteria (no LVSI, tumor diameter not exceeding 2 cm, depth of invasion not exceeding 10 mm, non-specialized histological type, and absence of metastatic radiological features) may also be suitable candidates for more conservative surgical options, such as conization or simple trachelectomy with lymph node surgery. This perspective is supported by the updated European guidelines of 2023 [26].

In general, FSTs are not recommended for patients with tumours ≥ 2 cm in diameter. However, for patients with tumours < 4 cm in diameter in stage IB2 who insist on FSTs after being fully informed of the benefits and risks, ART may be considered. Studies have shown that such patients can achieve better oncological outcomes and lower recurrence rates, although fertility outcomes remain less optimistic. There is currently a paucity of research supporting the feasibility of LRT, particularly with regard to oncological and recurrence outcomes, necessitating further investigation. For some patients with stages IB2 and IIA1, a combination of NACT and surgery may be considered, which has shown favorable pregnancy outcomes, but the recurrence rate remains a concern that requires close attention. However, consensus has not been reached on recommendations regarding the specific chemotherapy regimens, surgical approaches, or extent of resection.

In the cohort of patients undergoing RT, cervical insufficiency emerges as a principal cause of preterm birth. Despite the existing literature's inability to definitively establish the necessity for cerclage and its optimal timing, patients who conceive following FSTs should be considered to be at high risk for pregnancy. In accordance with current guidelines, the implementation of cerclage during the RT procedure was advocated. Although the risk of preterm birth persists, efforts should be made to prolong the gestational period as much as possible. Additionally, it is recommended that cesarean section is an optimal mode of delivery at the termination of pregnancy.

Over the past few decades, significant advancements have been made in the field of FSTs for cervical cancer, yet a consensus in clinical practice remains elusive regarding the multifaceted management and application of these interventions. Current research suggests that, with the aim of ensuring favorable tumor and pregnancy outcomes, conservation therapies tend to lean towards more conservative surgical approaches, particularly for early-stage and low-risk patients. The formulation of treatment strategies requires a comprehensive evaluation of various factors, including tumor size, lymph node involvement, patients' desires for future fertility, technological capabilities, and the availability of medical resources. In-depth communication between surgeons and patients is

essential to ensure that informed decisions can be made prior to any clinical decision-making. Further research is needed to explore the potential of more conservative treatment approaches to enhance tumor and pregnancy outcomes. For patients with tumours larger than 2 cm, identifying the appropriate treatment modality remains an area that requires additional work. Moreover, efforts to enhance the feasibility and effectiveness of these FSTs from an evidence-based medicine perspective demand persistent and dedicated endeavors. Through these comprehensive research and practice initiatives, we can hope to provide more precise and personalized treatment options for patients with cervical cancer in the future.

Our study has certain limitations. First of all, in the literature search and screening process, we set some language and stylistic restrictions, and some relevant articles may be missed. Second, we ranked them by number of citations, and some recently published important thought articles were not heavily cited for time reasons and were not included in our study, potentially influencing the results.

5. Conclusion

We identified the T100 articles on FSTs for cervical cancer, with the USA as the largest contributor in terms of authors and institutions. Most articles in this area were published in *Gynecologic Oncology*. Different RT surgical methods and their combinations have been the focus of research in this field and will continue to be the focus of research in the future, and the combination of NACT with conservative surgery, conization and simple trachelectomy will become a more important research trend in the future.

Ethics statement

Review and/or approval by an ethics committee was not needed for this study because this study was an analysis based on the literature and did not involve human or animal studies.

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Data availability statement

The authors declare that database used in the study is from publicly literature, or are available from the corresponding author on written request.

CRedit authorship contribution statement

Xuji Jiang: Writing – original draft, Investigation, Data curation. **Chuanli Feng:** Methodology, Investigation. **Wanying Sun:** Software, Data curation. **Teng Zhang:** Supervision. **Baoxia Cui:** Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Baoxia cui reports financial support was provided by National Key R&D Program of China. Teng Zhang reports financial support was provided by National Key R&D Program of China. Teng Zhang reports financial support was provided by National Natural Science Foundation of China. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

List of abbreviations

| | |
|---------------|--|
| FSTs | Fertility-sparing treatments |
| VRT | Vaginal radical trachelectomy |
| WOSCC | Web of Science Core Collection |
| T100 articles | Top 100 most cited articles |
| PLND | Pelvic lymph node dissection |
| RT | Radical trachelectomy |
| RH | Radical hysterectomy |
| SLNB | Sentinel lymph node biopsy |
| SLNs | Sentinel lymph nodes |
| NACT | Neoadjuvant chemotherapy |
| ART | Abdominal radical trachelectomy |
| MIS-RT | Minimally invasive radical trachelectomy |
| LRT | Laparoscopic radical trachelectomy |

RRT Robotic-assisted laparoscopic radical trachelectomy

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e31738>.

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