Bibliometric Keyword Analysis Across Fifteen Years (2004–2018) of Knee Surgery and Related Research Articles

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Abstract

Background: Bibliometric is a branch of library science that uses mathematical and statistical techniques to analyze articles and the ‘keyword’ describes the most important concept of the article among the structure of the articles of journal. There was no bibliometric analysis that only analyzed the keywords of articles published in a specific single journal focusing on knee-related surgery. The authors analyzed the keywords of the articles published in the Knee Surgery and Related Research (KSRR), which is an official journal of the Korean Knee Society for the last 15 years to identify popular research topics in the field of knee.

Methods: Of the 622 articles published in the KSRR from 2004 to 2018, 424 original articles were analyzed and a total of 1,703 keywords were extracted. The authors selected and classified ‘keyword categories’ to comprehensively analyze each keyword describing the same research topic. Among them, the authors selected the top 20 keywords and analyzed research concepts using related keywords. Keywords were classified by publication year to analyze the frequency and tendency of the keywords used in each study.

Results: The frequency of use of the top 20 keywords accounted for 48.2% of the keywords used in the journal for the last 15 years. Excluding the keyword “knee”, which represents the affected joint, the top 5 keywords most commonly used were “total knee arthroplasty (TKA)”, “osteoarthritis”, “anterior cruciate ligament reconstruction”, “meniscus”, and “navigation”. The top 5 keywords used together with “TKA”, were “navigation”, “infection”, “management of posterior cruciate ligament”, “transfusion”, and “revision”.

Conclusions: We conducted bibliometric research for the KSRR across a 15-year span. The results help define an overall command of the latest topics in knee research and provide insight for launching new projects.

Background

Bibliometric is a branch of library science that uses mathematical and statistical techniques to analyze books, articles, and other documents [1]. Keywords represent the author’s opinion by selecting three or six of the most important words in their articles. In addition, keyword analysis allows us to analyze not only the present but also past research trends. Finally, keyword analysis provides insight into the most popular research topics in the journal, the characteristics of the keywords used with a particular keyword, and the increase or decrease in the use of keywords over time.

In the orthopedic field, there are various bibliometric analysis studies [2~6]. However, to date, there was no bibliometric analysis that only analyzed the keywords of articles published in a specific single journal focusing on knee-related surgery. This study focused only on the keywords of the article, not the author, country, and citation index of the article, to determine what keywords were used frequently, the relationship between keywords, and the change in the appearance of keywords according to the year of publication.
This study focused on bibliometric for the journal, The Knee Surgery and Related Research (Knee Surg Relat Res (KSRR), ISO abbreviation). The KSRR is the official journal of the Korean Knee Society (KKS) and made its debut on September 2011, replacing The Journal of Korean Knee Society published since 1989 by KKS. This journal covers all fields of clinical knee surgery and basic research related to knee surgery.

Here we attempt to build on existing bibliometric analysis for this journal, KSRR. Our goal is to provide bibliometric information focusing specially on keywords of articles published in the KSRR.

Methods

1. Data collection

A search of the literature conducted using an online database to identify all literature published in KSRR from January 1, 2004 to December 31, 2018. Two authors classified all literature by type of publication and reviewed literature to clarify the keywords of articles. There were 6 document types involving 622 articles from 2004–2018 identified by the database in the online version of KSRR web. The document types of articles are shown in Figure 1. The original articles were the largest with 424, 68.2%, followed by case reports with 17.7% (n = 110), review articles with 10.0% (n = 62), technical notes 1.8% (n = 11), editorial materials 1.6% (n = 10), and other formats 0.8% (n = 5). Original articles were analyzed as part of the study, and the results are shown in the following paragraphs.

2. Coding the keywords

Coding the keywords was sometimes not as simple. In the process of collecting the keywords used by the authors in each research article, it was confirmed that various keywords were used to describe the same research topic. For example, it has been confirmed that “total knee arthroplasty”, “total knee replacement”, “TKA”, “TKR” and “arthroplasty” were used as keywords to describe total knee arthroplasty. Accordingly, the authors selected and classified ‘keyword categories’ to comprehensively analyze each keyword describing the same research topic. To select ‘keyword categories’ and classify the keywords into each ‘keyword categories’, three board-certified orthopedic surgeons held a consensus meeting to derive opinions.

3. Analysis strategy for keyword trends

Keywords were classified by publication year to analyze the frequency and tendency of the keywords used in each study. Since then, the publication period for 15 years has been categorized into each 5 years, divided into 2004–2008 (phase I), 2009–2013 (phase II), and 2014–2018 (phase III).

Results

The total number of keywords used in the 424 original articles published over the past 15 years was 1,703, of which the 20 most used keywords are shown in Table 1. “Total knee arthroplasty (TKA)”, a
keyword indicating the type of surgery, was most frequently used, except for “knee”, a keyword indicating affected joints, followed by “osteoarthritis (OA)”, a keyword indicating diagnosis.

**Rank 2 “TKA”**

Excluding the keyword “knee”, there were 885 keywords used with the most used keyword “TKA”. Among them, the 10 most used keywords after excluding the keyword “knee” and the keyword “OA (used 19 times)” are shown in Table 2. Among the 10 keywords, the keywords related to the surgical technique that can be controlled were “navigation”, “posterior cruciate retaining (CR) or substituting (PS)”, “posterior tibial slope (PTS)”, “tourniquet”, and “minimal invasive surgery (MIS)”. Keywords related to the perioperative situation that cannot be controlled were “infection”, “transfusion”, “revision”, “blood loss”, and “range of motion (ROM)”.

**Rank 4 “anterior cruciate ligament (ACL) reconstruction”**

Of the 96 keywords used with “ACL reconstruction”, which is the 4th ranked keyword in the overall ranking, 17 were keywords related to graft used during surgery, and 16 were keywords related to evaluation tool after surgery. After that, keywords for techniques related to femoral tunnel drilling were used 14 times. Among them, “trans-tibial (TT) technique”, “outside-in (OI) technique”, and “anteromedial (AM) portal technique” were used 7 times, 5 times, and 2 times, respectively. The keyword “three-dimensional computed tomography (3D-CT)”, which means imaging modality for the location of the femoral tunnel, was used a total of 4times. A research article using the two keywords “TT technique” and “OT technique” at the same time was first published in 2013. Since then, the use of "TT technique", "OI technique", "AM portal technique", and "3D-CT" as keywords has steadily increased, and in some articles, two or more keywords have been used simultaneously (Figure 2).

**Rank 5 “navigation”**

The keyword “navigation” was used in studies related to TKA in 92% (23 times), and the other two were used in studies on closed tibial osteotomy and anterior cruciate ligament, respectively. Analyzing the number of uses of the keyword “navigation” according to the 5-year-phase, it was found that it was used 8 times in phase I, 9 times in phase II, and 6 times in phase III.

**Rank 7 “osteootomy”**

The keyword ranked 7th in the frequency of use was used 28 times. 85.7% of the total was used to represent high tibial osteotomy (HTO) – the treatment of medial OA – and according to the surgical technique, open wedge (OW) and closed wedge (CW) accounted for 64.3% (18 times) and 21.4% (6 times), respectively. The remaining 14.3% (4 times) was used to represent the bone resection technique used during TKA or revision TKA surgery. Because of analyzing the number of uses of "osteootomy”, which means HTO by 5-year-phase, it was found that OW-HTO was used 1, 3, and 14 times in phase I, II, and III, respectively, and CW-HTO was used 3, 1, and 2 times, respectively (Figure 3). In addition, since 2013, the
cumulative number of uses of OW-HTO as a keyword overcome the cumulative number of uses of CWHTO (Figure 4).

**Rank 11 “unicompartmental knee arthroplasty (UKA)”**

The keyword “UKA” as a type of surgery has been used 18 times, and has been used 8 times in the last 5 years (phase III), accounting for 44.4% of the total. Among the keywords used with “UKA”, there were three types of surgery. “osteotomy” and “TKA” were used in a comparative study with UKA surgery, and “revision arthroplasty” was used to mean TKA performed as a treatment modality for complications that occurred after UKA surgery.

**Rank 17 “ROM”**

The keyword “ROM” was used 14 times, of which 11 times were used in TKA-related studies. The remaining 3 times were used in studies related to revision TKA, UKA, and arthrofibrosis, respectively.

**Rank 17 “PTS”**

The keyword “PTS” was used 14 times, among them, 11 times were used in TKA-related studies, 2 times were used in ACL-related studies, and 1 time was used in meniscus-related study.

**Rank 9, 14, 19**

95% of the keyword “infection” and 88% of the keyword “revision” were used in TKA-related studies, and the entire of the keyword “blood loss” was used in TKA-related studies.

**Discussion**

This study conducted a bibliometric analysis on the types and frequency of keywords used in the last 15 years in a journal dealing with knee surgery related research, and additional keywords used along with the keywords included in the top 20.

Excluding the keyword “knee”, which represents an affected joint, the top 5 keywords most commonly used were “TKA”, “OA”, “ACL reconstruction”, “meniscus”, and “navigation”. The top 5 keywords can be said to represent the most common research topic among recent studies conducted in the field of knee joints.

Jones and Jerabek [8] found that the studies related to TKA surgery over the past 20 years are related to perioperative variables that orthopedic surgeons can control, such as lower leg alignment, soft tissue balance, joint line maintenance and alignment, sizing and fixation of components. Through this study, the authors confirmed that the keywords frequently used with the keyword “TKA” were perioperative variables that orthopedic surgeons can control or not.
According to Australian Hip and Knee Arthroplasty Register data, it was reported that the use of the navigation system for knee arthroplasty increased from 2.4% in 2003 to 22.8% in 2013 [9]. Although the frequency of use of the keyword suggested in this study cannot mean the frequency of use of the actual navigation system, the use of “navigation” as a keyword in KSRR has continuously increased over the past 15 years. In review articles on the current concept and future perspective of computer-assisted navigated TKA, Matsumoto et al. [10] announced that it is unlikely that more navigation systems will be used in the near future because of the emergence of more affordable and patient-specific technologies. In a review article on the role of navigation in orthopedic surgery, Karkenny et al. [11] mentioned the possibility of surface-based registration using navigation for tunnel position during ACL reconstruction surgery, as well as navigated arthroplasty techniques. This study confirmed that “navigation” as a keyword used in studies related to TKA in 92% of the total. As mentioned by Karkenny et al. [11], in the future KSRR, it is thought that it is necessary to present research using navigation in the field of arthroscopic surgery or fracture surgery.

In the process of performing TKA surgery, surgeons decide whether to sacrifice or retain the posterior cruciate ligament (PCL). “CR or PS”, keyword related to this technique, has been used steadily over the past 15 years and has used 18 times, ranking in the 11th place among the commonly used keywords. According to the worldwide national joint registries in Latin America, 73% of all patients performed TKA surgery with PCL sacrificing and 18% with cruciate retaining, so PCL management during TKA surgery was still controversial [12].

In the studies that analyzed preferences and trends for the ACL reconstruction procedure in a survey format, five surveys favored of AM portal technique and the remaining two in favor of TT technique. However, the tendency of preference for a specific technique according to the time of publication of the research paper was not confirmed [13]. Among the articles on ACL reconstruction published in KSRR, it was confirmed that a comparative study between techniques related to femoral tunnel drilling began in 2013. Although the TT technique was the most frequently mentioned keyword, there is a limit to the assumption that the TT technique is most commonly used as a technique for femoral tunnel drilling because the TT technique has been mentioned as a conventional technique to compare with the new technique.

Zhang H et al. [14] conducted bibliometric analysis on HTO research trends over the past 20 years and introduced ‘study on bone union and plate fixation at osteotomy’ and ‘surgical technique research’ as hotspots related to HTO research. They compared OW-HTO and CW-HTO as surgical techniques and described their advantages and disadvantages. Among the “osteotomy” as a keyword used in KSRR, the cumulative number of uses of OW-HTO and CW-HTO is golden-cross in 2013, and after that, the increase in OW-HTO as keyword can be considered the trend of recent KSRR research.

Holzer LA and Holzer G [15] conducted bibliometric analysis on UKA research and showed the distribution of articles according to publication decades. They reported that articles published in the 2000s and 2010s accounted for more than half of all articles published from 1981 to 2014. The average number of
articles published per year was 0.78, 1.3, and 2.3 per year in the 1980s, 1990s, and 2000s, showing a steadily increasing trend, but in the 2010s, it was estimated that 1.4 articles were published per year. "UKA" as a keyword used in KSRR for the last 5 years (phase III) accounted for 44.4% of the total use. However, according to the 5-year-phase, the frequency of use of phase I (6), phase II (4), and phase III (8) was shown, making it difficult to interpret that there was a clear trend of increase or decrease.

This study has several limitations. First, the number of keywords used does not represent the number of actual surgery performed. Second, because keywords used in one journal were analyzed, and it does not reflect global research trends. Third, two authors performed keyword analysis and classification, and consensus on the differences, but the subjective opinions of researchers cannot be excluded in classifying keywords. Lastly, the number of keywords used have been underestimated compared to the frequency of the research topic, as there have been some studies that did not use the corresponding keyword, although it was a study on a specific surgery.

**Conclusion**

This study analyzed the original articles published in the KSRR for the past 15 years and determined the keywords frequently used in the articles and trends. It is expected that the results of this study will help many researchers and readers understand what research topics have frequently been dealt with in KSRR and what detailed research topics will be needed.

**List Of Abbreviations**

KSRR *Knee Surgery and Related Research*

KKS *Korean Knee Society*

TKA Total knee arthroplasty

OA Osteoarthritis

CR Posterior cruciate retaining

PS Posterior cruciate substituting

PTS Posterior tibial slope

MIS Minimal invasive surgery

ROM range of motion

ACL Anterior cruciate ligament

TT Trans-tibial
OI Outside-in

AM Anteromedial

3D-CT Three-dimensional computed tomography

HTO High tibial osteotomy

OW Open wedge

CW Closed wedge

UKA Unicompartmental knee arthroplasty

PCL Posterior cruciate ligament

Declarations

Authors’ contributions

Conceptualization: Young-Dae Jeon and Ki-Bong Park. Literature search: Young-Dae Jeon and Seong-Min Jang. Data extraction: Jung-Won Han. Formal analysis: Ki-Bong Park and Seong-Min Jang. Writing: Young-Dae Jeon and Seong-Min Jang. Manuscript revision: Sang-Hun Ko and Ki-Bong Park. The authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are not publicly available due to feasibility but are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.
References

1. Similowski T, Derenne JP. Bibliometry of biomedical periodicals. Rev Mal Respir. 1995;12:543-50.
2. Lefaivre KA, Shadgan B, O'Brien PJ. 100 most cited articles in orthopaedic surgery. Clin Orthop Relat Res. 2011;469:1487-97.
3. Lee KM, Ryu MS, Chung CY, Choi IH, Kwon DG, Kim TW, et al. Characteristics and trends of orthopedic publications between 2000 and 2009. Clin Orthop Surg. 2011;3:225-9.
4. Holzer LA, Holzer G. Analysis of scientific articles published in two general orthopaedic journals. Acta Ortop Bras. 2013;21:281-4.
5. Eom SH, Bamne AB, Chowdhry M, Chae IS, Kim TK. Bibliometric Analysis of Orthopedic Literature on Total Knee Arthroplasty in Asian Countries: A 10-year Analysis. Knee Surg Relat Res. 2015;27:149-55.
6. Kambhampati SBS, Vaishya R. Trends in Publications on the Anterior Cruciate Ligament Over the Past 40 Years on PubMed. Orthop J Sports Med. 2019;7:2325967119856883.
7. Park SH, Jung KH, Chang SW, Jang SM, Park KB. Trends in knee surgery research in the official journal of the Korean Knee Society during the period 1999-2018: a bibliometric review. Knee Surg Relat Res. 2020;32:28.
8. Jones CW, Jerabek SA. Current Role of Computer Navigation in Total Knee Arthroplasty. J Arthroplasty. 2018;33:1989-93.
9. de Steiger RN, Liu YL, Graves SE. Computer navigation for total knee arthroplasty reduces revision rate for patients less than sixty-five years of age. J Bone Joint Surg Am. 2015;97:635-42.
10. Matsumoto T, Nakano N, Lawrence JE, Khanduja V. Current concepts and future perspectives in computer-assisted navigated total knee replacement. Int Orthop. 2019;43:1337-43.
11. Karkenny AJ, Mendelis JR, Geller DS, Gomez JA. The Role of Intraoperative Navigation in Orthopaedic Surgery. J Am Acad Orthop Surg. 2019;27:e849-58.
12. Figueroa D, Figueroa F, Calvo R, Vaisman A, Figueroa M, Putnis S. Trends in Total Knee Arthroplasty in a Developing Region: A Survey of Latin American Orthopaedic Surgeons. J Am Acad Orthop Surg. 2020;28:189-93.
13. Grassi A, Carulli C, Innocenti M, Mosca M, Zaffagnini S, Bait C; SIGASCOT Arthroscopy Committee. New Trends in Anterior Cruciate Ligament Reconstruction: A Systematic Review of National Surveys of the Last 5 Years. Joints. 2018;6:177-87.
14. Zhang H, Fan Y, Wang R, Feng W, Chen J, Deng P, Qi X, Ye P, Li Y, Li J, Zeng J, Zeng Y. Research trends and hotspots of high tibial osteotomy in two decades (from 2001 to 2020): a bibliometric analysis. J Orthop Surg Res. 2020;15:512.
15. Holzer LA, Holzer G. The most influential papers in unicompartmental knee arthroplasty. Knee Surg Relat Res. 2020;32:54.

Tables
Table 1.
Top twenty most popular of the 1,703 keywords in the original articles

| Rank | Keyword       | Overall Numbers (%) | Rank | Keyword          | Overall Numbers (%) |
|------|---------------|---------------------|------|------------------|---------------------|
| 1    | Knee          | 228 (13.4)          | 11   | CR or PS         | 18 (1.1)            |
| 2    | TKA           | 220 (12.9)          | 12   | UKA              | 18 (1.1)            |
| 3    | OA            | 57 (3.3)            | 13   | MRI              | 17 (1)              |
| 4    | ACLR          | 43 (2.5)            | 14   | Transfusion      | 16 (0.9)            |
| 5    | Meniscus      | 25 (1.5)            | 15   | Cr: posterior cruciate retaining | 16 (0.9) |
| 6    | Navigation    | 25 (1.5)            | 16   | Bearing          | 15 (0.9)            |
| 7    | Osteotomy     | 24 (1.4)            | 17   | Range of motion  | 14 (0.8)            |
| 8    | Arthroscopy   | 24 (1.4)            | 18   | Posterior tibial slope | 14 (0.8) |
| 9    | Infection     | 20 (1.2)            | 19   | ACL (no recon)   | 12 (0.7)            |
| 10   | varus         | 19 (1.1)            | 20   | Blood loss       | 12 (0.7)            |

TKA: total knee arthroplasty, OA: osteoarthritis, ACLR: anterior cruciate ligament reconstruction, CR: posterior cruciate retaining, PS: posterior cruciate substituting, UKA: unicompartmental knee arthroplasty, MRI: magnetic resonance imaging, ACL: anterior cruciate ligament

Table 2.
Top ten most frequently occurring keywords related to the “total knee arthroplasty”

| Rank | Keyword                                         | Overall Numbers (%) |
|------|-------------------------------------------------|---------------------|
| 1    | Navigation                                      | 23 (3.8%)           |
| 2    | Infection                                       | 19 (3.2%)           |
| 3    | CR or PS                                        | 17 (2.8%)           |
| 4    | Transfusion                                     | 15 (2.5%)           |
| 5    | Revision                                        | 14 (2.3%)           |
| 6    | Blood loss                                      | 12 (2.0%)           |
| 7    | Posterior tibial slope, Range of motion         | 11 (1.8%)           |
| 8    | Tourniquet, Minimal invasive surgery            | 10 (1.7%)           |

CR: posterior cruciate retaining, PS: posterior cruciate substituting