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REVIEW

Global Research Trends on Medial Meniscus Posterior Root Tear: A 20-Year Bibliometric Analysis

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Background: The medial meniscus posterior root tear (MMPRT) is a clinically significant injury recognized to accelerate cartilage degeneration. In recent years, research on MMPRT has expanded significantly, involving novel surgical techniques, biomechanical implications, and prognostic factors. This study aims to conduct a bibliometric analysis of MMPRT research focusing on research trends, predominant contributors, and emerging hotspots.

Methods: The Web of Science Core Collection served as the data source. Only original articles published in English from January 1, 2004, to December 31, 2024, were considered eligible. The titles, authors, publication year, country, journals, keywords, and citation frequency were collected for comprehensive analysis. Descriptive statistical analysis was performed using the bibliometrix package in R, and VOSviewer was employed for network analysis and visualization, including co-citation analysis, coupling analysis, collaboration analysis, and co-occurrence analysis.

Results: A total of 590 articles about MMPRT were included. Knee Surgery Sports Traumatology Arthroscopy (KSSTA), American Journal of Sports Medicine (AJSM), and Arthroscopy-The Journal of Arthroscopic And Related Surgery (Arthroscopy) emerged as the three predominant journals through co-citation analysis and coupling analysis. Furumatsu T emerged as the most prolific author, and Laprade RF emerged as the most influential author. The United States was the top contributor in the field of MMPRT research, and the collaboration between Korean research institutions is very close. The most frequent keyword was Horn, occurring 161 times. The keyword co-occurrence analysis revealed meniscal repair techniques and prognosis, especially biomechanical consequences, as the research hotspots.

Conclusion: The field of MMPRT is undergoing rapid development, with the United States, Japan, and South Korea at the forefront of the world. It is expected that the field of MMPRT will remain active and achieve significant advancements. Presently, the research is focused on optimizing repair techniques and conducting biomechanical assessments. Our study provides valuable insights into future research directions and facilitates the translation of research findings into clinical practice.

Keywords: meniscus, medial meniscus posterior root tear, bibliometric, VOSviewer, global research status

Introduction

The medial meniscus posterior root tear (MMPRT) is a clinically significant injury characterized by avulsion of the posterior root attachment of the medial meniscus.[1–3] As a critical structure for maintaining joint biomechanics, the medial meniscus plays a pivotal role in shock absorption and force distribution.[4,5] Correspondingly, MMPRT disrupts these mechanisms, leading to meniscal extrusion and cartilage degeneration.[6–8] In recent years, research on MMPRT has

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expanded significantly, involving novel surgical techniques, biomechanical implications, and prognostic factors.[9–11] However, a comprehensive and systematic summary of MMPRT is still lacking.

Bibliometric analysis emerges as a quantitative method for evaluating scholarly output.[12–14] In contrast to traditional narrative reviews, this approach employs statistical and network visualization techniques to objectively map the development of research fields.[15,16] By analyzing publication trends, collaboration networks, and keyword evolution, this approach facilitates identifying current research status, emerging hotspots, and outlining future research directions.[17–19] Vieider et al conducted a bibliometric analysis of the 50 most cited studies on meniscus root tears published between 1990 and 2024. Their findings revealed an average of 165 ± 100 citations per study, with the majority of these studies originating from the United States. The most common types of studies were clinical and biomechanical studies.[20] Although several bibliometric studies have provided valuable insights into meniscal root tears or related surgical techniques, there is a lack of a systematic analysis of research trends, predominant contributors, and emerging hotspots of MMPRT.[20–22]

This study aims to conduct a bibliometric analysis of MMPRT research published between 2004 and 2024. By examining publication trends, influential journals and authors, leading institutions and countries, and the co-occurrence of keywords, we seek to identify the current research status, hotspots, and frontiers of MMPRT. Specifically, the identification of emerging hotspots, such as advanced repair techniques, biomechanical outcomes will help prioritize future research efforts and facilitate the translation of evidence into clinical practice.

Methods

Data Sources and Search Strategy

The Web of Science Core Collection served as the data source based on its comprehensive and authoritative indexing of orthopedic journals. Publications from January 1, 2004, to December 31, 2024, were included to capture over two decades of advancements in MMPRT. The literature search was performed by the first author (JWZ). We selected synonymous terms of MMPRT and used these to develop the search strategy. Synonyms such as “root tear”, “root avulsion”, and “root injury” were combined using the Boolean operator “OR” to maximize retrieval of relevant publications. The Boolean search query was designed as follows: (((TS=(medial meniscus posterior root tear)) OR TS=(MMPRT)) OR TS=(medial meniscus posterior root avulsion)) OR TS=(medial meniscus posterior root injury). Only original articles published in English were considered eligible.

Data Screening and Extraction

Two researchers independently performed the screening using a three-stage protocol. First, the non-original articles such as reviews and editorials were removed via database filters. Second, the studies unrelated to MMPRT were removed via title or abstract review. Third, the discrepancies between the two researchers were resolved through discussion or referred to the third researcher for adjudication. The titles, authors, publication year, country, journals, keywords, and citation frequency were collected for comprehensive analysis.

Data Analysis and Visualization

Descriptive statistical analysis was performed using the bibliometrix package in R (version 4.1.3, R Foundation for Statistical Computing, Vienna, Austria), and VOSviewer (version 1.6.18, Leiden University’s Center for Science and Technology Studies, Netherlands) was employed for network analysis and visualization, including co-citation analysis, coupling analysis, collaboration analysis, and co-occurrence analysis. In a bibliometric analysis, if two elements are cited by a third element, then these two elements have a co-citation relationship. Coupling analysis can be seen as the mirror image of co-citation analysis. It is the relationship between two or more elements that cite the same third element.[23–25] In the network visualization map, each node represents an indicator, including journal, institution, country, and keyword. The nodes with the same color belong to the same cluster, indicating similar properties within the network.[26]

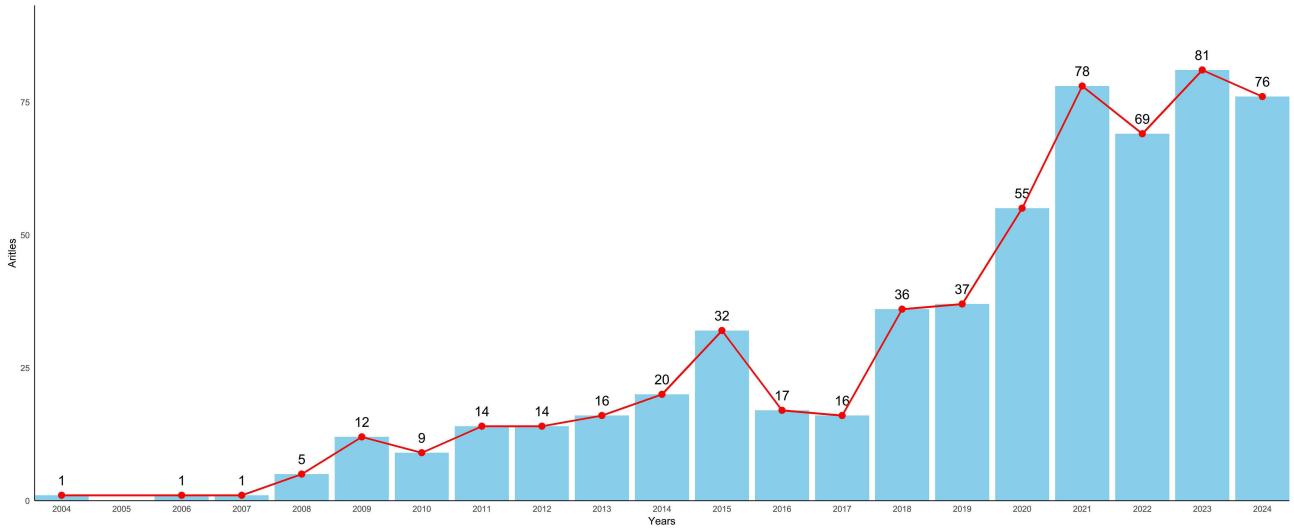

Figure 1 The trend analysis of publications from 2004 to 2024.

Results

Publication Trends

A total of 590 articles about MMPRT were included. As shown in Figure 1, there was a steady rise in publications from 2004 to 2024, reflecting increasing clinical and academic interest in MMPRT.

Analysis of Productive Journals

A total of 100 journals were included, and the total citations were 16050. Table 1 shows the top 10 most prolific journals. Knee Surgery Sports Traumatology Arthroscopy (KSSTA) emerged as the most prolific journal with 103 articles. American Journal of Sports Medicine (AJSM) emerged as the most influential journal, with 67 articles receiving 4461 total citations. As shown in Figure 2, KSSTA, AJSM, and Arthroscopy-The Journal of Arthroscopic And Related Surgery (Arthroscopy) emerged as the three predominant journals through co-citation analysis and coupling analysis, serving as a pivotal nexus point.

Analysis of Authors

A total of 331 authors were included. Table 2 shows the top 10 most prolific authors. Furumatsu T emerged as the most prolific author with 81 articles receiving 1060 total citations, while Laprade RF emerged as the most influential author with 37 articles receiving 3166 total citations.

Table 1 Top 10 Journals in Terms of Number of Publications

Journal	Articles	Total Citations	Average Citations
Knee Surgery Sports Traumatology Arthroscopy	103	3282	31.86
American Journal of Sports Medicine	67	4461	66.58
Arthroscopy Techniques	47	163	3.47
Arthroscopy-The Journal of Arthroscopic And Related Surgery	34	2116	62.24
Knee	34	505	14.85
Orthopaedic Journal of Sports Medicine	27	318	11.78
Journal of Experimental Orthopaedics	13	257	19.77
Journal of Orthopaedic Science	13	52	4.00
Archives of Orthopaedic And Trauma Surgery	12	482	40.17
BMC Musculoskeletal Disorders	12	71	5.92

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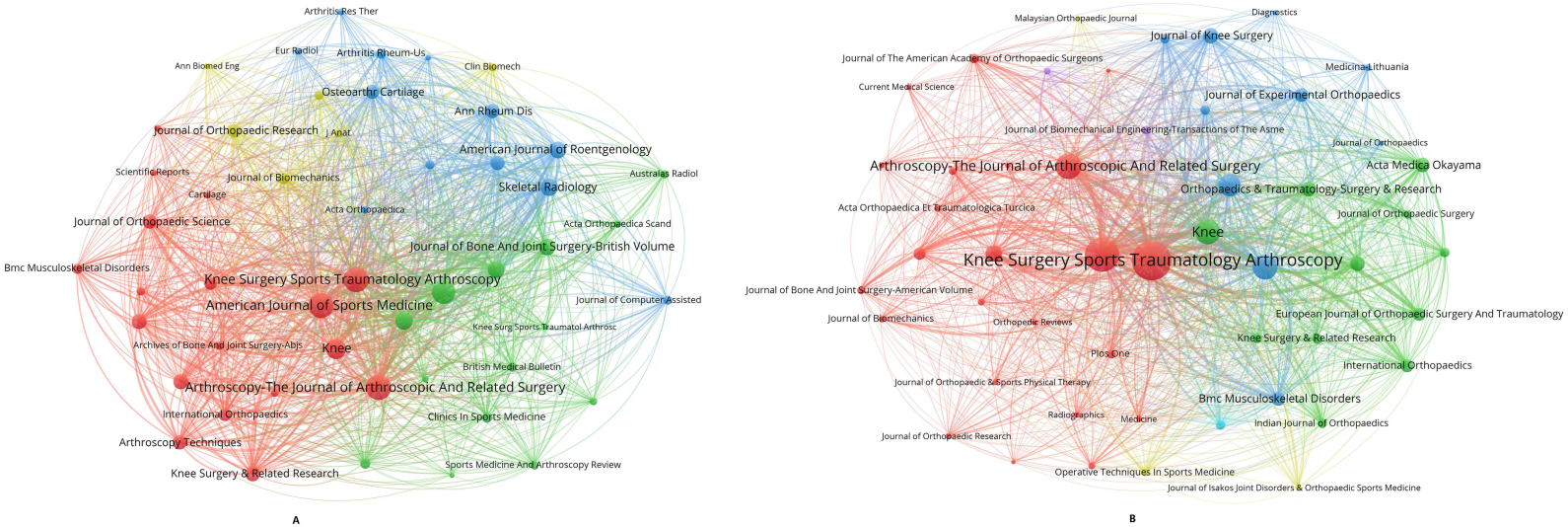

Figure 2 The network visualization map of co-citation analysis and coupling analysis of journals. Each node represents a journal. The size of the node indicates the total link strength in network analysis. The larger the node, the more connections within the network, indicating greater influence and a central position within the field. (**A**) The co-citation analysis of journals. (**B**) The coupling citation analysis of journals.

Table 2 Top 10 Authors in Terms of Number of Publications

Authors	Articles	Total Citations	H_index
Furumatsu T	81	1060	20
Laprade RF	37	3166	28
Kim JG	18	1408	17
Krych AJ	17	903	14
Bin SI	8	288	7
Koga H	6	174	7
Dzidzishvili L	5	36	4
Feucht MJ	5	515	10
Lee YS	5	614	7
Nakase J	5	45	4

Analysis of Institutions and Countries

A total of 470 institutions and 33 countries were included. As shown in Figure 3, Okayama University emerged as the most prolific institution with 96 articles, followed by Inje University and the Steadman Philippon Research Institute. As shown in Table 3, the United States was the top contributor in the field of MMPRT research, contributing 170 articles and receiving 7199 total citations. The network visualization map of collaboration analysis between institutions revealed geographic clustering, with the United States, Korea, and Europe serving as regional centers. Especially, the collaboration between Korean research institutions is very close. The network visualization map of collaboration analysis between countries revealed the United States as the central hub, demonstrating its scientific dominance in the global research of MMPRT (Figure 4).

Keyword Analysis and Research Hotspots

A total of 573 keywords were included. The most frequent keyword was Horn occurring 161 times, followed by Biomechanical Consequences occurring 148 times, and Knee occurring 133 times. The top 50 most frequent keywords were clustered based on the co-occurrence analysis, and 4 clusters were obtained. The keyword co-occurrence analysis

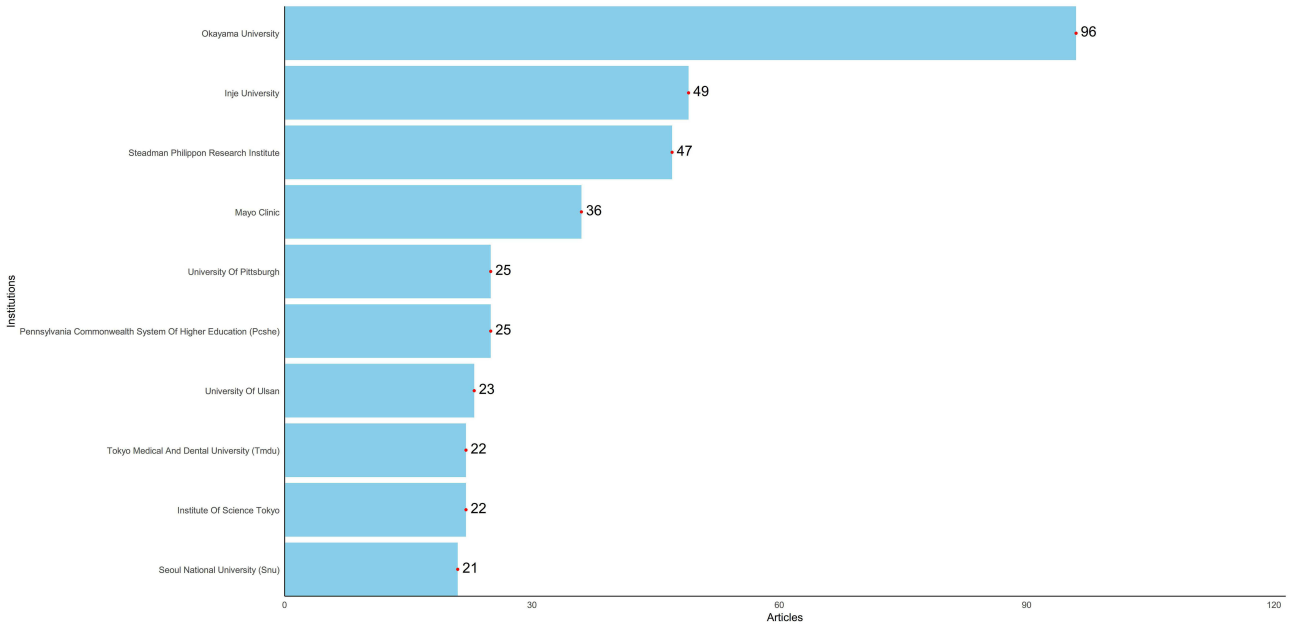

Figure 3 Top 10 institutions in terms of the number of publications.

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Table 3 Top 10 Countries in Terms of Number of Publications

Countries	Articles	Total Citations	Average Citations
United States	170	7199	42.35
Japan	142	1618	11.39
Korea	105	4493	42.79
China	45	399	8.87
Germany	23	943	41.00
Spain	11	112	10.18
Thailand	9	21	2.33
France	8	167	20.88
Italy	8	66	8.25
Turkey	8	318	39.75

revealed meniscal repair techniques and prognosis, especially biomechanical consequences, as the research hotspots (Figure 5).

Discussion

Our study systematically evaluated the developmental trajectory of MMPRT research from 2004 to 2024. Since 2004, the number of articles has shown significant growth, reaching a peak of 81 articles in 2023. Notably, the three leading journals, including KSSTA, AJSM, and Arthroscopy contributed 204 articles, accounting for 36.78% of total publications, and received 9859 citations accounting for 61.43% of the total citations, which underscores their academic leadership in MMPRT research.

The analysis of collaboration networks of institutions and countries identified three distinct geographical clusters, including the United States, Korea, and Europe. The United States maintained a dominant position, followed by Japan, which produced 142 articles. Notably, Korea demonstrated higher total and average citation counts than Japan, highlighting its academic impact. This academic influence can be attributed to effective and highly collaborative framework, which is built through intensive bilateral and multilateral partnerships. A representative example is a multi-institutional biomechanical study on MMPRT, where Inje University and Konkuk University supplied essential resources and expertise, with additional contributions from Hanyang University, Sungkyunkwan University, and Jungwon University.[27] This cooperative model not only facilitates high-quality research output but also significantly enhances the academic influence of participating institutions.

The co-occurrence analysis of keywords indicated that biomechanical consequences and optimization of meniscal repair techniques such as pull-out repair are the current focal points. Meniscal repair aims to restore the anatomical integrity and biomechanical function of the meniscus, which can reduce abnormal loading on cartilage and prevent the progression of knee osteoarthritis.[28,29] Allaire et al demonstrated that MMPRT resulted in a 25% increase in peak contact pressure within the medial compartment, whereas the meniscal repair restores the peak contact pressure to normal levels.[30] Through a systematic evaluation of 28 studies, Chang et al demonstrated that clinical function scores, including the Lysholm, International Knee Documentation Committee (IKDC), Hospital for Special Surgery, and Tegner scores, improved significantly following MMPRT repair.[31]

The methods for MMPRT repair primarily included arthroscopic suture anchor repair and arthroscopic transtibial pull-out repair (ATPR).[32,33] In a prospective study conducted by Kim et al, both the suture anchor repair and ATPR groups exhibited significant functional improvements.[32] Regarding the selection of surgical techniques for MMPRT repair, it is imperative to consider both biomechanical evidence and clinical practicality. Some studies have demonstrated that suture anchor repair may offer superior reduction in meniscal extrusion and medial compartment contact pressure compared with ATPR.[34,35] Despite these findings, given that suture anchor repair is technically challenging and the potential risks for cartilage and neurovascular tissue damage, most surgeons prefer ATPR for MMPRT.[33,36] The increasing research interest in ATPR is attributed to its capacity to restore native meniscal anatomy and hoop tension distribution. Additionally, ATPR offers relatively simplified learning process and potentially reduced complication rates.

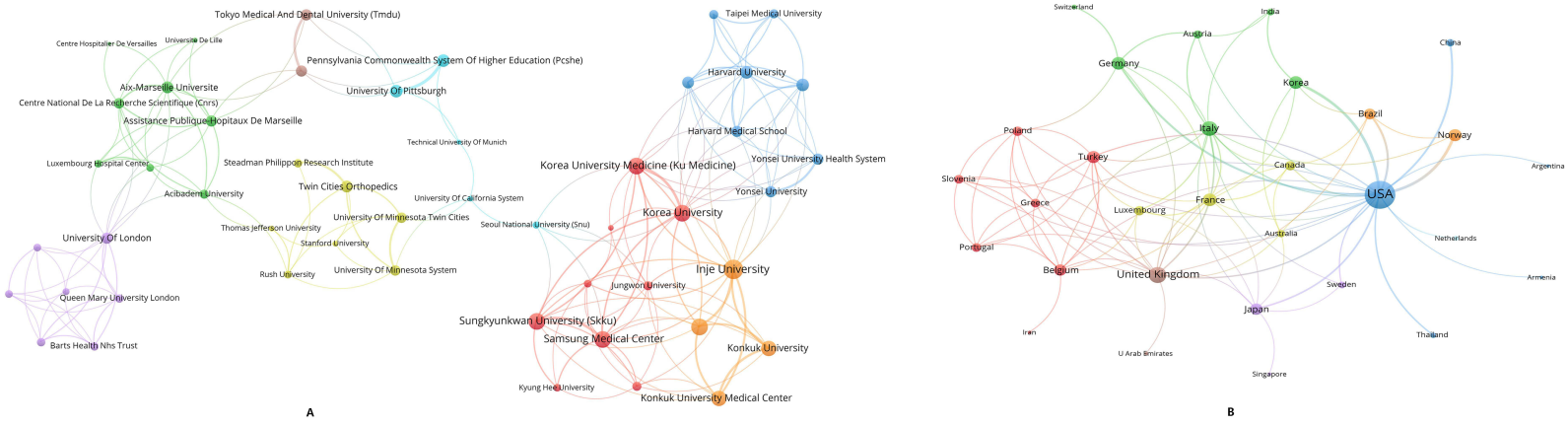

Figure 4 The network visualization map of collaboration between institutions and countries. (**A**) The collaboration between institutions. (**B**) The collaboration between countries.

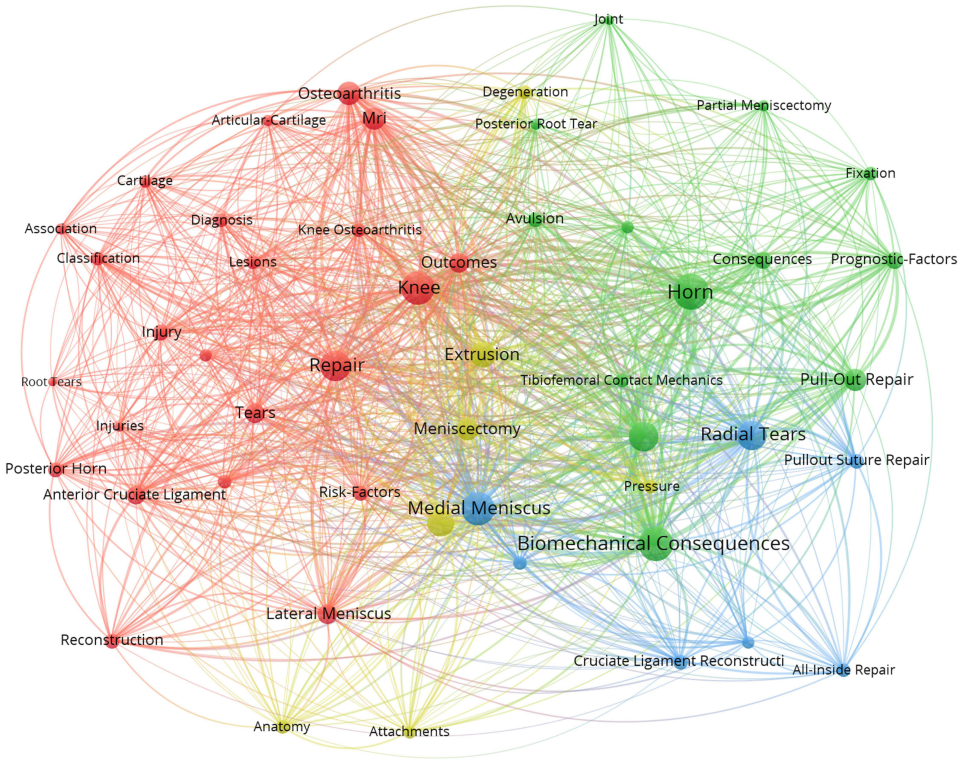

Figure 5 The network visualization map of the co-occurrence analysis of keywords. Each node represents a keyword. The size of the node indicates the frequency of the keyword in the literatures. The larger the node, the higher the frequency of the keyword in the literatures. The keywords of the same color belong to the same cluster, indicating similar properties within the network. The red cluster was mainly related to anatomy, clinical diagnostics, and treatment. The green cluster was mainly related to the treatment approach and prognosis, especially biomechanical consequences. The blue cluster was mainly related to the optimization of repair techniques such as pull-out repair. The yellow cluster was mainly related to the meniscectomy and prognosis.

Several studies have demonstrated the therapeutic benefits of ATPR in enhancing knee function scores and preventing the progression of osteoarthritis associated with MMPRT. Feucht et al systematically reviewed ATPR efficacy for MMPRT, revealing significant short-term improvements in knee function scores and potential inhibition of osteoarthritis progression in the majority of patients.[33] In a retrospective study comparing ATPR to conservative treatment, Ahn et al reported that ATPR significantly enhanced the IKDC score, as well as the Tegner and Lysholm scores of patients.[37] Additionally, in a study comparing ATPR to partial meniscectomy, Chung et al demonstrated that ATPR achieves superior outcomes in both the Lysholm score and the IKDC score.[38] Collectively, these studies validated ATPR as a functionally and structurally superior intervention for MMPRT.

Individualized rehabilitation protocols are crucial for optimizing outcomes following MMPRT repair. In fact, there is no established consensus regarding the optimal postoperative rehabilitation protocols, particularly in terms of the timing of range of motion (ROM) exercises, weight-bearing (WB), return to sports (RTS), and brace utilization.[39–42] A systematic review has highlighted significant heterogeneity across included studies. Among 12 studies that addressed ROM initiation, ROM exercises within 1–2 days postoperatively were recommended by 5 studies, whereas the others suggested immobilization for 2–3 weeks before ROM exercises. Similarly, among 13 studies investigating WB, the initiation of partial WB between 1–4 weeks after surgery was recommended by 8 studies, while the others recommended delaying until 6 weeks after surgery.[42] This variability underscores the necessity of customizing rehabilitation plans based on individual patient factors, such as age, tissue healing quality, and concomitant surgical procedures.

Future research should build upon the identified emerging hotspots, such as advanced repair techniques, biomechanical outcomes, and prognostic factors. Through multi-institutional collaboration, the emerging research fields can be further explored, thereby facilitating the translation of research findings into clinical practice.

Limitation

This study has several limitations. First, the search was limited to the Web of Science Core Collection database, which may result in selection bias by omitting relevant studies available in other major databases, such as Scopus and PubMed. Second, the bibliometric analysis was dependent on the accuracy of keywords. The studies that did not employ conventional terminology may have been excluded. Third, the study concentrated on English literature, possibly neglecting significant research published in other languages, which may result in an underrepresentation of the scientific advancements originating from non-English regions. Despite these limitations, this study provides valuable insights for clinicians regarding the current status and prospects of MMPRT.

Conclusion

Overall, the field of MMPRT is undergoing rapid development, with the United States, Japan, and South Korea at the forefront of the world. It is expected that the field of MMPRT will remain active and achieve significant advancements. Presently, the research is focused on optimizing repair techniques and conducting biomechanical assessments. Our study provides valuable insights into future research directions and facilitates the translation of research findings into clinical practice.

Data Sharing Statement

The original data associated with this study has not been deposited into any publicly available repository, as the data used to support the results of this study are provided by the Web of Science Core Collection with permission. Additional data will be made available on request to the corresponding authors.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest in this work.

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