International Journal of Research in Orthopaedics
McKinley MT et al. Int J Res Orthop. 2026 May;12(3):738-746
http://www.ijoro.org

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20261223

Systematic Review

Current trends in articular cartilage research: a bibliometric analysis of the 50 most-cited clinical articles over the last 10 years

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Received: 18 January 2026
Revised: 24 February 2026
Accepted: 01 April 2026

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ABSTRACT

Articular cartilage lesions are a frequently encountered pathology during arthroscopic procedures and present a significant challenge. The purpose of this study was to conduct a bibliometric analysis to identify the 50 most cited clinical publications on treatments for cartilage surgery from the past decade, providing an updated overview of influential research and emerging trends in treatment strategies. A literature search was performed in October 2025 using the search terms of “cartilage treatment” OR “cartilage surgery” OR “cartilage repair” were used and filtered to include only those published between 2015 through 2025. The 50 most cited articles were identified and independently reviewed by two authors. Methodological quality was assessed using the Modified Coleman Score, and randomized controlled trials (RCTs) were evaluated using the Revised Tool for Risk of Bias in Randomized Trials (RoB 2.0) tool. A total of 21,640 articles were identified in the initial search. The 50 most cited articles were published between January 2015 and January 2021 and had 6407 total citations (mean±standard deviation, 128.1±63.2) (range, 73-366). Study designs of most cited articles included case series (n=26 studies, 52%), RCTs (n=12 studies, 24%), and cohort (n=12 studies, 24%) designs. The mean modified Coleman was 68.0±8.8 (range, 53-85). The journals publishing the most cited articles were the American Journal of Sports Medicine and Cartilage. High-impact cartilage research has shifted toward MSC-based therapies, surpassing ACI/MACI, while overall methodological quality continues to improve.

Keywords: Cartilage repair, Bibliometric analysis, Autologous chondrocyte implantation, Mesenchymal stem cells, Osteochondral allograft, Cartilage surgery

INTRODUCTION

Articular cartilage lesions are frequently observed and commonly encountered during arthroscopy procedures. Despite their common occurrence, treatment of these lesions presents a challenge in orthopaedics.[1] The avascular nature of cartilage coupled with the limited proliferative potential of its chondrocytes and an inability to recruit extrinsic repair cells, leads to an insufficient spontaneous repair response and complicates restoration of lesion or damage to the structure.[2,3] While definitive treatment has yet to be established, failure to address cartilage lesions has been associated with worse outcomes.[4] The progression of these lesions emphasizes the importance of timely intervention. The lack of a universally accepted gold standard of treatment over the past several decades has driven substantial research into this topic.[5-8] Numerous cartilage repair interventions such as autologous chondrocyte implantation (ACI), subchondral marrow stimulation, mesenchymal stem cells (MSCs) osteochondral autograft transplantation (OAT), and osteochondral allograft (OCA) transplantation, have been developed to address cartilage defects.[9-14] Given the differing techniques and investigation of each treatment's efficacy, it is important to explore the most impactful studies that seek to manage cartilage lesions.[10,11]

Bibliometric analysis provides a quantitative approach to explore the influence of scientific literature.[15] Within orthopaedics, bibliometric analyses have been used to identify the most influential clinical publications and are able to track evolving research trends.[16] These analyses use of citation counts offer a reliable metric that highlights past and current trends of a particular topic.[17] Using this type of analysis enables a better understanding of cartilage treatment development and the identification of the current most influential clinical articles. While previous studies have examined the totality of the clinical cartilage literature, to our knowledge no study has characterized recent literary trends in this rapidly evolving topic.[17,18] Due to the complexity and prevalence of articular cartilage lesions, it is important to understand the available treatment options and the most current literature. Previous research has compiled the most cited articles on this topic, but few have updated these findings to reflect the most recent literature. Therefore, the purpose of this study was to conduct a bibliometric approach to identify the 50 most cited clinical publications on treatments for cartilage surgery from the past decade, providing an updated overview of influential research and emerging trends in treatment strategies.

METHODS

A literature search was performed in October 2025 for clinical studies on cartilage surgery and eligible articles were found using the Scopus, PubMed, and Web of Science databases. The terms utilized in the literature search were “cartilage treatment” OR “cartilage surgery” OR “cartilage repair” and filtered to include only those published between 2015 through 2025. All studies were then downloaded and placed into Microsoft Excel (Microsoft Excel, Version 16.100.4, Microsoft Corporation, Redmond, WA). Data was then sorted in descending order according to total number of citations and screened using the criteria of (1) relevance to cartilage lesions, (2) inclusion of treatment by procedural intervention (3) reporting of patient follow-up data post-treatment. Inclusion criteria consisted of original research published on cartilage surgery. Studies were excluded if they were review articles, book chapters, retracted articles, errata, books, short surveys, editorials, and non-peer-reviewed content. Screening was performed until the top 50 most cited articles were found. Data extraction was performed by MM and OO and included the following: the total number of citations, citation density (per year), authors, institution, country of origin, year publication, journal of publication, number of patients, type of cartilage technique utilized, mean follow up period, number of patients, and study design. The literature search, article screening, and data extraction were performed independently by MM and OO. A third author JC was available for review and discussion in the case of conflicts until consensus had been met.

Quality of evidence assessment

The quality of each eligible study’s methodology was assessed using the Modified Coleman Score, which was completed by authors MM and OO.[19] A third author, JC. was available in the case of discrepancies, which did not arise. If the study was a randomized controlled trials (RCT) the RoB 2.0 tool (Revised Tool for Risk of Bias in Randomized Trails) was used to evaluate the methodological quality of each study (Figure 1).[20]

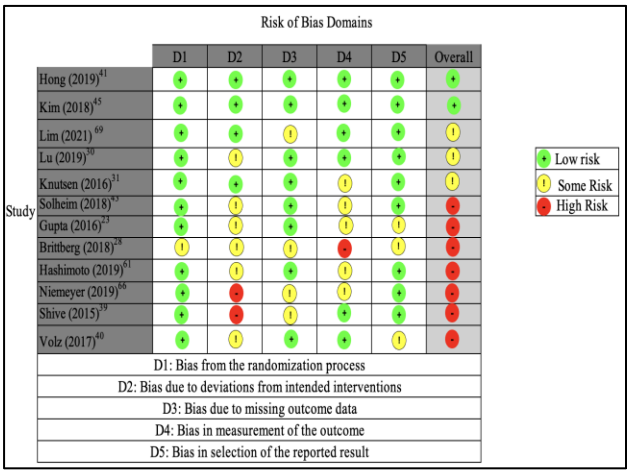

Figure 1: Risk of bias assessment using Cochrane risk of bias tool 2.0 for randomized controlled trials.

Statistical analysis

RStudio (RStudio, PBC, Boston, MA) was used for all statistical analyses. Citation density was calculated by finding the total number of citations and dividing them by the number of years since publication. A p-value <0.05 was considered statistically significant in the present study.

RESULTS

A total of 21,640 articles were identified from the PubMed, Scopus, and Web of Science databases published from 2015-2025 (Figure 2). Following article screening, the top 50 most cited articles were then identified with publication dates ranging from January 2015 to January 2021 (Table 1). In total, the Top 50 articles were cited a total of 6407 times (mean±standard deviation, 128.1±63.2) (median, IQR, 102, 81.0-156.8) (range, 73-366). Citation density, calculated as the number of citations per year of publication, ranged from 7.7 to 40.67 (mean, 16.2±7.5) citations per year. The most cited years by citation count were 2016 (15 citations), 2015 (10 citations), and 2017 (8 citations), while there were no studies included in the years 2022-2025. Importantly, 2025 was only aggregated from the first nine months of the year as the search was conducted in late September 2025.

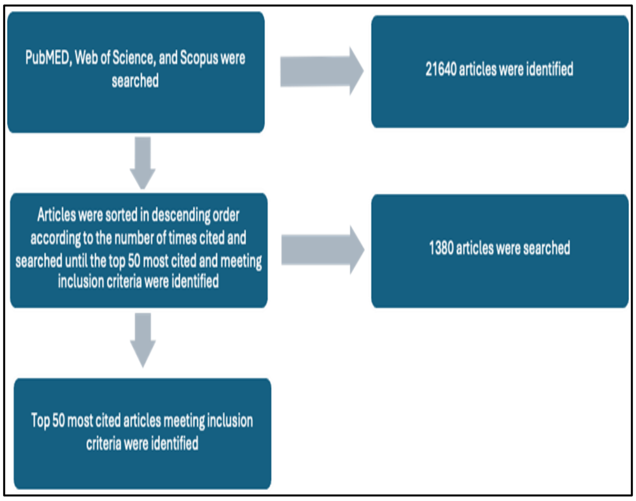

Figure 2: PRISMA flow chart.

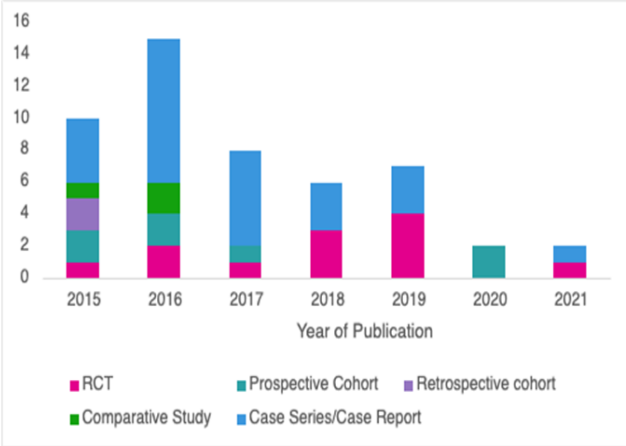

Figure 3: Number of 50 most cited articles by study design.

The most common study designs of the selected articles were case series (n=26 studies, 52%), RCTs (n=12 studies, 24%), and cohort (n=12 studies, 24%) (Figure 3). The mean modified Coleman score for the selected articles was 68.0±8.8 (range, 53-85). The most productive year of most cited publications was 2016 (n=15 studies, 30%), while least productive years were 2022-2025 (Figure 4).

Table 1: The 50 most-cited publications (2015-2025) on cartilage surgery.

Rank	Article	Times cited	Citation density	Coleman score
1	Stem cells translational medicine[7]	366	40.7	54
2	Arthritis research and therapy[23]	280	31.1	69
3	Arthroscopy: the journal of arthroscopic and related surgery[24]	236	26.2	64
4	American journal of sports medicine[28]	231	33.0	78
5	Lancet[29]	216	24.0	57
6	Stem cell research and therapy[30]	212	35.3	72
7	Journal of bone and joint surgery America[31]	209	23.2	79
8	Stem cells[32]	208	26.0	57
9	Clinical orthopedics and related research[33]	189	18.9	61
10	American journal of sports medicine[34]	170	18.9	71
11	International journal of rheumatic diseases[35]	169	18.8	60
12	Cartilage[36]	157	15.7	62
13	The knee[37]	157	17.4	56
14	Stem cells translational medicine[38]	156	17.3	68
15	Cartilage[39]	156	15.6	76
16	International orthopedics[40]	149	18.6	70
17	International orthopedics[41]	148	24.7	64
18	American journal of sports medicine[42]	140	17.5	83
19	American journal of sports medicine[43]	135	19.3	78
20	Stem cells[44]	117	14.6	62
21	Knee surgery, sports traumatology, arthroscopy[45]	107	13.4	65
22	American journal of sports medicine[46]	104	13	81
23	Knee surgery, sports traumatology, arthroscopy[25]	104	11.6	57
24	American journal of sports medicine[47]	102	10.2	67
25	NPJ regenerative medicine[48]	102	17.0	60
26	Human gene therapy clinical development[49]	102	14.6	77

Continued.

Rank	Article	Times cited	Citation density	Coleman score
27	Arthroscopy: the journal of arthroscopic and related surgery[50]	101	11.2	63
28	American journal of sports medicine[51]	97	9.7	72
29	The knee[52]	97	9.7	53
30	American journal of sports medicine[53]	94	11.8	64
31	Orthopedics journal of sports medicine[54]	89	14.8	66
32	American journal of sports medicine[55]	89	11.1	85
33	American journal of sports medicine[56]	89	9.8	72
34	Osteoarthritis and cartilage[57]	88	9.7	70
35	Bone and joint journal[58]	87	8.7	64
36	Journal of gene medicine[59]	85	10.6	58
37	American journal of sports medicine[60]	84	14.0	65
38	Regenerative therapy[61]	80	13.3	58
39	Cartilage[62]	79	11.2	67
40	Cartilage[63]	79	7.9	80
41	Cartilage[64]	78	7.8	82
42	Knee surgery, sports traumatology, arthroscopy[65]	77	7.7	72
43	Orthopedics journal of sports medicine[66]	76	12.6	81
44	International journal of orthopedics[67]	75	8.3	61
45	Cartilage[68]	74	18.5	67
46	Orthopedics journal of sports medicine[69]	74	18.5	79
47	Cartilage[70]	74	14.8	82
48	American journal of sports medicine[71]	73	14.6	55
49	American journal of sports medicine[72]	73	10.4	66
50	Journal of orthopedics and traumatology[21]	73	8.1	68

Table 2: Characteristics of journals publishing the top 50 cited studies in cartilage research 2015-2025.

Journal	No. of articles (%)	Mean citation density	Total number of citations	Mean Coleman score
American journal of sports medicine	13 (26)	14.9	1481	72.1
Cartilage	7 (14)	13.1	697	73.7
Arthroscopy: the journal of arthroscopic and related surgery	2 (4)	18.7	337	63.5
Knee surgery, sports traumatology, arthroscopy	3 (6)	10.9	288	64.7
International orthopedics	3 (6)	17.2	372	65.0
The knee	2 (4)	13.6	254	54.5
Orthopedics journal of sports medicine	3 (6)	15.3	239	75.3
Stem cells	2 (4)	20.3	325	59.5
Stem cells translational medicine	2 (4)	29.0	522	61.0
Arthritis research and therapy	1 (2)	31.1	280	69.0
Bone and joint journal	1 (2)	8.7	87	64.0
Clinical orthopedics and related research	1 (2)	18.9	189	61.0
Human gene therapy clinical development	1 (2)	14.6	102	77.0
Internation journal of rheumatic diseases	1 (2)	18.8	169	60.0
Journal of bone and joint surgery America	1 (2)	23.2	209	79.0
Journal of gene medicine	1 (2)	10.6	85	58.0
Lancet	1 (2)	24.0	216	57.0

Continued.

Journal	No. of articles (%)	Mean citation density	Total number of citations	Mean Coleman score
NPJ regenerative medicine	1 (2)	17.0	102	60.0
Osteoarthritis and cartilage	1 (2)	9.7	88	70.0
Regenerative therapy	1 (2)	13.3	79	58.0
Stem cells research and therapy	1 (2)	35.3	212	72.0
Journal of orthopedics and traumatology	1 (2)	8.1	73	68.0

The journals where the most cited articles most frequently appeared were American Journal of Sports Medicine (n= 13 studies, 26%) and Cartilage (n=7 studies, 14%) (Table 2). The most cited article was published in Stem Cells Translational Medicine while the least cited article was published in Journal of Orthopaedics and Traumatology.[7,21]

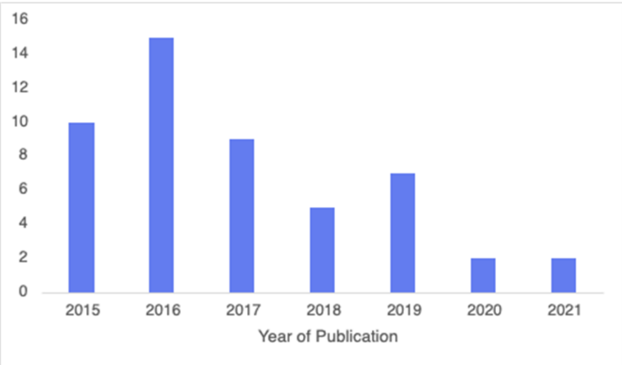

Figure 4: Number of 50 most cited articles per year of publication.

Authorship was divided among home institutions from 17 different countries spanning over 5 continents. The countries contributing the most articles were the United States (n=9 articles, 18%), Italy (n=7 articles, 14%), and Republic of Korea (n=6 articles, 12%).

Table 3: Techniques of the top 50 cited studies in cartilage research 2015-2025.

Type of cartilage procedure	Techniques investigated in articles (%)
MSC	18 (35)
MACI/ACI	13 (25)
OCA	8 (15)
OAT	4 (7)
Microfracture	3(6)
Other	6 (12)

The institutions with the most contributed articles were Department of Orthopaedic Surgery, Scripps Clinic (n=4 articles, 8%), Rush University Medical Centre (n=3, 6%), and Department of Orthopaedic Surgery, Yonsei Sarang Hospital (n=3 articles, 6%). Authors such as Dr. Alberto Gobbi (n=4 articles, 8%), Dr. Brian Cole (n=3, 6%) Dr. Yong-Sang Kim (n=3 articles, 6%), and Chul-Won Ha (n =3 articles, 6%) contributed the most selected articles out of the top 50 most cited cartilage research papers over the last decade. The most frequently cited treatments reported on by the selected articles were MSC (n=18 articles, 36%), (MACI/ACI) (n=13 articles, 25%), and OCA (n=8 articles, 16%) (Table 3). The anatomical regions of interest most frequently focused on included knee (n=46, 92%), ankle (n =2 articles, 4%), knee and ankle (n=1 articles, 2%), and hip (n=1 article, 2%).

DISCUSSION

The findings of this analysis of the current trends in cartilage repair research from 2015-2025 lend insight into several important findings. Case series/case reports (52%), RCTs (24%), and cohort studies (24%) were the most frequent studies included in the analysis, indicating many of the most influential articles in cartilage repair are lower levels of evidence. MSC (36%) and cell-based cartilage repair techniques, such as ACI/MACI (25%) and were the most frequently investigated repair techniques. The United States, Italy, and the Republic of Korea were the countries that had the greatest number of articles included in this study. Articles published in 2016 accrued the most citations, followed by 2015 and 2017, respectively. Despite searching for articles published through 2025, none of the top 50 most cited articles were published in the past 3 years. Lastly, the American Journal of Sports Medicine (26%) was the journal that published the most papers on cartilage repair studies.

The majority of studies included in the Top 50 were case series or reports, which suggests that some of the most influential literature in cartilage repair consists of lower levels of evidence. The modified Coleman score was utilized to determine the methodological quality of the selected articles. The mean modified Coleman score for the Top 50 was 68.0, which is higher than previously reported (68.0 vs. 61.0).[18] However, Franceschini et al did describe a trend of 14 of their more recent papers in their study having higher modified Coleman scores of 71.0.[18] Given the articles included in the present study are more recently published, they follow this trend, which emphasizes that methodological quality and study design have been improving with time, regardless of the level of evidence.

Previous studies have indicated that cell-based cartilage techniques, such as ACI/MACI, are effective and have continued to grow in clinical use, frequently appearing in the top cited literature.[18] The findings of the present study are broadly consistent with these trends but reveal a notable shift in research focus. Specifically, MSC based studies have surpassed ACI/MACI as the most frequently cited technique within the top 50 articles over the past decade. MSCs have been increasing in prominence, perhaps due the generally less invasive mode of application, via intra-articular injection or mini arthrotomy, and the possible benefit of cartilage regeneration, as opposed to OAT or OAC, where previously matured tissue is transferred to the recipient.[22] In fact, the top three most cited articles in this study were investigating the use of stem cells and accounted for 882 times cited. These findings underscore the academic and clinical interests in biological augmentation using MSCs and suggest that future research is heading more into this direction and away from structural restoration alone, such as OAT and OAC, and even further away from previous first line techniques, such as microfracture.[7,23,24]

Similarly, there have been other shifts in the frequency of techniques discussed in the 50 most cited papers from the past 10 years when compared with previous bibliometric analyses. Whereas Franceschini et al found microfracture and OAT to be the second and third, most cited techniques, respectively, the past ten years of literature have investigated the use of ACI/MACI and OCA more frequently than microfracture and OAT.[18] The distribution of publication by country is similar as previously described, with the United States (n=9) the top countries publishing research on cartilage repair, however, Italy (n= 7) and the Republic of Korea (n= 6) were second and third, respectively. These findings suggest that interest and influence of cartilage repair techniques have only been increasing globally, and future findings will be from a global community as opposed to only a few countries alone.

Based on the findings of the present study, future cartilage research may take place globally, as technology has made the dissemination of information and techniques less difficult to pursue and learn. MSC transplantation has seen increased interest, likely due to its biologic regenerative possibilities. ACI/MACI currently remains an area of intense interest for cartilage repair, however, future research in this area of cartilage research may purse acellular based scaffolds, as can be seen in Christensen et al's study, which investigated an acellular scaffold consisting of type I collagen and hydroxyapatite, but led to poor results.[25-27] Despite these poor results, this is a newer subject of cartilage research and there is ample opportunity to improve. More broadly, there has been significant improvement in the quality of studies; however, more RCTs are needed for both ACI/MACI and MSCs to determine the efficacy, long-term outcomes, and safety of these cartilage repair techniques.

Limitations

This study is not without limitations. First, many of the studies included in analysis are not of the highest quality and a majority are level IV evidence, while a minority are Level I or II. Additionally, this study investigated the years of 2015-2025, however, there were no articles included from the years 2022-2025. This is likely due to chronological bias as articles gain citation counts with time. Although citation density was applied to mitigate this bias, based on the included articles, there is still bias present. Another limitation is due to a lack of long-term follow-up in many of the included studies, which may be due to overcrowding by other studies which investigate more novel techniques.

CONCLUSION

This bibliometric review demonstrates a shift in high-impact cartilage research toward MSC-based therapies, which now surpass ACI/MACI as the most frequently cited techniques. Although lower-level evidence still predominates, overall methodological quality of cartilage research is improving.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Falah M, Nierenberg G, Soudry M, Hayden M, Volpin G. Treatment of articular cartilage lesions of the knee. Int Orthop. 2010;34(5):621-30.
2. Mithoefer K. Complex Articular Cartilage Restoration. Sports Med Arthrosc Rev. 2013;21(1):31-7.
3. Fox AJ, Bedi A, Rodeo SA. The Basic Science of Articular Cartilage: Structure, Composition, and Function. Sports Health. 2009;1(6):461-8.
4. Davies-Tuck ML, Wluka AE, Wang Y, Teichtahl AJ, Davis SR, Strauss BJ, et al. The natural history of cartilage defects in people with knee osteoarthritis. Osteoarthritis Cartilage. 2008;16(3):337-42.
5. Mowers CC, Lack BT, Childers JT, Jackson GR. Inconsistencies in clinically significant outcome metrics for knee cartilage repair: a systematic review. Musculoskelet Surg. 2025;109(4):369-80.
6. Redondo ML, Beer AJ, Yanke AB. Cartilage Restoration: Microfracture and Osteochondral Autograft Transplantation. J Knee Surg. 2018;31(3):231-8.
7. Park YB, Ha CW, Lee CH, Yoon YC, Park YG. Cartilage Regeneration in Osteoarthritic Patients by a Composite of Allogeneic Umbilical Cord Blood-Derived Mesenchymal Stem Cells and Hyaluronate Hydrogel: Results from a Clinical Trial for Safety and Proof-of-Concept with 7 Years of Extended Follow-Up. Stem Cells Transl Med. 2016;6(2):613-21.
8. Meyer LE, Hurley ET, Danilkowicz RM, Alaia MJ, Dickens JF, Espregueria-Mendes J, et al. Concomitant procedures for knee cartilage injuries—an international Delphi consensus statement. J Cartil Joint Preserv. 2024;4(3):100198.
9. Tan SHS, Kwan YT, Neo WJ, Chong JY, Kuek TYJ, See JZF, et al. Intra-articular injections of

mesenchymal stem cells without adjuvant therapies for knee osteoarthritis: a systematic review and meta-analysis. Am J Sports Med. 2021;49(11):3113-24.
10. Familiari F, Shanmugaraj A, Browatzki A, Scheffler SU, Hirschmann MT. Clinical Outcomes and Failure Rates of Osteochondral Allograft Transplantation in the Knee: A Systematic Review. Am J Sports Med. 2017;46(13):3541-9.
11. Hoffman JK, Geraghty S, Protzman NM. Articular Cartilage Repair Using Marrow Stimulation Augmented with a Viable Chondral Allograft: 9-Month Postoperative Histological Evaluation. Case Rep Orthop. 2015;2015:617365.
12. Trofa DP, Hong IS, Lopez CD, Rao AJ, Yu Z, Odum SM, et al. Isolated Osteochondral Autograft Versus Allograft Transplantation for the Treatment of Symptomatic Cartilage Lesions of the Knee: A Systematic Review and Meta-analysis. Am J Sports Med. 2023;51(3):812-24.
13. Dasari SP, Jawanda H, Mameri ES, Fortier LM, Polce EM, Kerzner B, et al. Single-stage autologous cartilage repair results in positive patient-reported outcomes for chondral lesions of the knee: a systematic review. J ISAKOS. 2023;8(5):372-80.
14. Xie JF, Jackson GR, Childers JT, Lack BT, Mowers CC, DeFroda SF, et al. Variable Return-to-Sport Rates with Improved Pain and Patient-Reported Outcomes Following Osteochondral Allograft Transplantation: A Systematic Review. J Knee Surg. 2025;38(11):563-74.
15. Kumar LM, George RJ, Anisha PS. Bibliometric analysis for medical research. Indian J Psychol Med. 2023;45(3):277-82.
16. Lefaivre KA, Shadgan B, O'Brien PJ. 100 most cited articles in orthopaedic surgery. Clin Orthop Relat Res. 2011;469(5):1487-97.
17. Donthu N, Kumar S, Mukherjee D, Pandey N, Lim WM. How to conduct a bibliometric analysis: an overview and guidelines. J Bus Res. 2021;133:285-96.
18. Franceschini M, Boffa A, Andriolo L, Di Martino A, Zaffagnini S, Filardo G. The 50 most-cited clinical articles in cartilage surgery research: a bibliometric analysis. Knee Surg Sports Traumatol Arthrosc. 2022;30(6):1901-14.
19. Coleman BD, Khan KM, Maffulli N, Cook JL, Wark JD. Studies of surgical outcome after patellar tendinopathy: clinical significance of methodological deficiencies and guidelines for future studies. Scand J Med Sci Sports. 2000;10(1):2-11.
20. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:l4898.
21. Rosa D, Balato G, Ciaramella G, Soscia E, Improta G, Triassi M. Long-term clinical results and MRI changes after autologous chondrocyte implantation in the knee of young and active middle-aged patients. J Orthop Traumatol. 2016;17(1):55-62.
22. Jaibaji M, Jaibaji R, Volpin A. Mesenchymal stem cells in the treatment of cartilage defects of the knee: a systematic review of the clinical outcomes. Am J Sports Med. 2021;49(13):3716-27.
23. Gupta PK, Chullikana A, Rengasamy M, Shetty N, Pandey V, Agarwal V, et al. Efficacy and safety of adult human bone marrow-derived, cultured, pooled, allogeneic mesenchymal stromal cells (Stempeucel®): Preclinical and clinical trial in osteoarthritis of the knee joint. Arthritis Res Ther. 2016;18(1):301.
24. Koh YG, Kwon OR, Kim YS, Choi YJ, Tak DH. Adipose-derived mesenchymal stem cells with microfracture versus microfracture alone: 2-year follow-up of a prospective randomized trial. Arthroscopy. 2016;32(1):97-109.
25. Christensen BB, Foldager CB, Jensen J, Jensen NC, Lind M. Poor osteochondral repair by a biomimetic collagen scaffold: 1- to 3-year clinical and radiological follow-up. Knee Surg Sports Traumatol Arthrosc. 2016;24(7):2380-7.
26. Nordberg RC, Bielajew BJ, Takahashi T, Dai S, Hu JC, Athanasiou KA. Recent advancements in cartilage tissue engineering innovation and translation. Nat Rev Rheumatol. 2024;20(6):323-46.
27. Abu Owida H. Recent Biomimetic Approaches for Articular Cartilage Tissue Engineering and Their Clinical Applications: Narrative Review of the Literature. Adv Orthop. 2022;2022:8670174.
28. Brittberg M, Recker D, Ilgenfritz J, Saris DBF. Matrix-applied characterized autologous cultured chondrocytes versus microfracture: five-year follow-up of a prospective randomized trial. Am J Sports Med. 2018;46(6):1343-51.
29. Mumme M, Barbero A, Miot S, Wixmerten A, Feliciano S, Wolf F, et al. Nasal chondrocyte-based engineered autologous cartilage tissue for repair of articular cartilage defects: an observational first-in-human trial. Lancet. 2016;388(10055):1985-94.
30. Lu L, Zhang Z, Yu X, Qiao Z, Shi D, Zhao B, et al. Treatment of knee osteoarthritis with intra-articular injection of autologous adipose-derived mesenchymal progenitor cells: a prospective, randomized, double-blind, active-controlled, phase IIb clinical trial. Stem Cell Res Ther. 2019;10(1):143.
31. Knutsen G, Drogset JO, Engebretsen L, Grøntvedt T, Ludvigsen TC, Løken S, et al. A Randomized Multicenter Trial Comparing Autologous Chondrocyte Implantation with Microfracture: Long-Term Follow-up at 14 to 15 Years. J Bone Joint Surg Am. 2016;98(16):1332-9.
32. De Windt TS, Vonk LA, Slaper-Cortenbach ICM, Van den Broek MPH, Nizak R, Van Rijen MHP, et al. Allogeneic Mesenchymal Stem Cells Stimulate Cartilage Regeneration and Are Safe for Single-Stage Cartilage Repair in Humans upon Mixture with Recycled Autologous Chondrons. Stem Cells. 2017;35(1):256-64.

33. Sekiya I, Muneta T, Horie M, Koga H. Arthroscopic transplantation of synovial stem cells improves clinical outcomes in knees with cartilage defects. Clin Orthop Relat Res. 2015;473(7):2316-26.
34. Gobbi A, Whyte GP. One-stage cartilage repair using a hyaluronic acid-based scaffold with activated bone marrow-derived mesenchymal stem cells compared with microfracture. Am J Sports Med. 2016;44(11):2846-54.
35. Davatchi F, Sadeghi Abdollahi B, Mohyeddin M, Nikbin B. Mesenchymal stem cell therapy for knee osteoarthritis: 5-year follow-up of three patients. Int J Rheum Dis. 2016;19(2):219-25.
36. Gobbi A, Chaurasia S, Karnatzikos G, Nakamura N. Matrix-induced autologous chondrocyte implantation versus multipotent stem cells for the treatment of large patellofemoral chondral lesions: a nonrandomized prospective trial. Cartilage. 2015;6(2):82-97.
37. Soler R, Orozco L, Munar A, Baguena M, Sánchez A, Garcia-Sánchez V, et al. Final results of a phase I-II trial using ex vivo expanded autologous mesenchymal stromal cells for the treatment of osteoarthritis of the knee confirming safety and suggesting cartilage regeneration. Knee. 2016;23(4):647-54.
38. Jiang Y, Tuan RS. Human cartilage-derived progenitor cells from committed chondrocytes for efficient cartilage repair and regeneration. Stem Cells Transl Med. 2016;5(6):733-44.
39. Shive MS, Demange MK, Nunes GS, Palmer MP, Xu A, Farr J, et al. BST-CarGel® treatment maintains cartilage repair superiority over microfracture at 5 years in a multicenter randomized controlled trial. Cartilage. 2015;6(1):62-72.
40. Volz M, Schaumburger J, Frick H, Grifka J, Anders S. A randomized controlled trial demonstrating sustained benefit of autologous matrix-induced chondrogenesis over microfracture at five years. Int Orthop. 2017;41(4):797-804.
41. Hong Z, Guo X, He Y, Song Y, Cao J, Li X, et al. Intra-articular injection of autologous adipose-derived stromal vascular fractions for knee osteoarthritis: a double-blind randomized self-controlled trial. Int Orthop. 2019;43(5):1123-34.
42. Frank RM, Lee S, Bush-Jacobson S, Cotter EJ, Strauss EJ, McCarty EC,, et al. Osteochondral allograft transplantation of the knee: analysis of failures at 5 years. Am J Sports Med. 2017;45(4):864-74.
43. Solheim E, Hegna J, Strand T, Harlem T, Inderhaug E. Randomized study of long-term (15–17 years) outcome after microfracture versus mosaicplasty in knee articular cartilage defects. Am J Sports Med. 2018;46(4):826-31.
44. De Windt TS, Vonk LA, Slaper-Cortenbach ICM, Van den Broek MPH, Nizak R, Van Rijen MHP, et al. Allogeneic MSCs and Recycled Autologous Chondrons Mixed in a One-Stage Cartilage Cell Transplantion: A First-in-Man Trial in 35 Patients. Stem Cells. 2017;35(8):1984-93.
45. Gobbi A, Bhupal S, Karnatzikos G, Lanzi JT. One-step surgery with multipotent stem cells and hyaluronan-based scaffold for the treatment of full-thickness chondral defects of the knee in patients older than 45 years. Knee Surg Sports Traumatol Arthrosc. 2017;25(8):2494-501.
46. Ogura T, Mosier BA, Bryant T, Minas T. A 20-year follow-up after first-generation autologous chondrocyte implantation. Am J Sports Med. 2017;45(12):2751-61.
47. Kim YS, Koh YG, Choi YJ, Kwon OR, Tak DH. Comparative matched-pair analysis of the injection versus implantation of mesenchymal stem cells for knee osteoarthritis. Am J Sports Med. 2015;43(11):2738-46.
48. Sato M, Yamato M, Mitani G, Takagaki T, Hamahashi K, Nakamura Y, et al. Combined surgery and chondrocyte cell-sheet transplantation improves clinical and structural outcomes in knee osteoarthritis. NPJ Regen Med. 2019;4:4.
49. Kim MK, Ha CW, In Y, Cho SD, Choi ES, Ha JK, et al. A Multicenter, Double-Blind, Phase III Clinical Trial to Evaluate the Efficacy and Safety of a Cell and Gene Therapy in Knee Osteoarthritis Patients. Hum Gene Ther Clin Dev. 2018;29(1):48-59.
50. Hannon CP, Ross KA, Crum RJ, Abouljoud MM, Clarke MT, Murawski CD, et al. Arthroscopic bone marrow stimulation and concentrated bone marrow aspirate for osteochondral lesions of the talus: a case-control study of functional and magnetic resonance observation of cartilage repair tissue outcomes. Arthroscopy. 2016;32(2):339-47.
51. Gracitelli GC, Meric G, Pulido PA, Bugbee WD. Fresh osteochondral allografts in the knee: comparison of primary transplantation versus transplantation after failure of previous subchondral marrow stimulation. Am J Sports Med. 2015;43(4):885-91.
52. Enea D, Vannini F, Cavallo M, Grigolo B, Facchini A. One-step cartilage repair in the knee: collagen-covered microfracture and autologous bone marrow concentrate — a pilot study. Knee. 2015;22(1):30-5.
53. Salonen EE, Nieminen MT, Koivikko MP, Parviainen MT, Kallio PE. Traumatic patellar dislocation and cartilage injury: a follow-up study of long-term cartilage deterioration. Am J Sports Med. 2017;45(6):1376-82.
54. Massen FK, Maldonado DR, Chen J, Klatt BA, Ferrer MG, Williams RJ , et al. One-step autologous minced cartilage procedure for the treatment of knee joint chondral and osteochondral lesions: a series of 27 patients with 2-year follow-up. Orthop J Sports Med. 2019;7(11):2325967119853773.
55. Nielsen ES, McCauley JC, Pulido PA, Bugbee WD. Return to sport and recreational activity after osteochondral allograft transplantation in the knee. Am J Sports Med. 2017;45(7):1608-14.

56. Ebert JR, Fallon M, Wood DJ, Janes GC. A prospective clinical and radiological evaluation at 5 years after arthroscopic matrix-induced autologous chondrocyte implantation. Am J Sports Med. 2017;45(1):59-69.
57. Kim YS, Koh YG, Choi YJ, Kwon OR, Tak DH. Assessment of clinical and MRI outcomes after mesenchymal stem cell implantation in patients with knee osteoarthritis: a prospective study. Osteoarthritis Cartilage. 2016;24(2):237-45.
58. Fontana A, De Girolamo L. Sustained five-year benefit of autologous matrix-induced chondrogenesis for femoral acetabular impingement-induced chondral lesions compared with microfracture treatment. Bone Joint J. 2015;97(5):628-35.
59. Spasovski D, Spasovski V, Baščarević Z, Stojiljković M, Vreća M, Anđelković M, et al. Intra-articular injection of autologous adipose-derived mesenchymal stem cells in the treatment of knee osteoarthritis. J Gene Med. 2018;20(1):e3002.
60. Gobbi A, Whyte GP. Long-term clinical outcomes of one-stage cartilage repair in the knee with hyaluronic acid-based scaffold embedded with mesenchymal stem cells sourced from bone marrow aspirate concentrate. Am J Sports Med. 2019;47(7):1621-8.
61. Hashimoto Y, Nishida Y, Takahashi S, Nakamura H, Mera H, Kashiwa K, et al. Transplantation of autologous bone marrow-derived mesenchymal stem cells under arthroscopic surgery with microfracture versus microfracture alone for articular cartilage lesions in the knee: A multicenter prospective randomized control clinical trial. Regen Ther. 2019;11:106-13.
62. Gille J, Behrens P, Schulz AP, Oheim R, Kienast B. Matrix-associated autologous chondrocyte implantation: a clinical follow-up at 15 years. Cartilage. 2016;7(4):309-15.
63. Gracitelli GC, Meric G, Pulido PA, McCauley JC, Bugbee WD. Osteochondral allograft transplantation for knee lesions after failure of cartilage repair surgery. Cartilage. 2015;6(1):98-105.
64. Briggs DT, Sadr KN, Pulido PA, Bugbee WD. The use of osteochondral allograft transplantation for primary treatment of cartilage lesions in the knee. Cartilage. 2015;6(2):203-7.
65. Basad E, Wissing FR, Fehrenbach P, Rickert M, Steinmeyer J, Ishaque B. Matrix-induced autologous chondrocyte implantation (MACI) in the knee: clinical outcomes and challenges. Knee Surg Sports Traumatol Arthrosc. 2015;23(12):3729-35.
66. Niemeyer P, Laute V, Zinser W, Becher C, Kolombe T, Fay J, et al. A Prospective, Randomized, Open-Label, Multicenter, Phase III Noninferiority Trial to Compare the Clinical Efficacy of Matrix-Associated Autologous Chondrocyte Implantation With Spheroid Technology Versus Arthroscopic Microfracture for Cartilage Defects o. Orthop J Sports Med. 2019;7(7):2325967119854442.
67. Kubosch EJ, Bode G, Südkamp NP, Niemeyer P. Clinical outcome and T2 assessment following autologous matrix-induced chondrogenesis in osteochondral lesions of the talus. Int Orthop. 2016;40(1):65-71.
68. Ogura T, Ackermann J, Mestriner AB, Merkely G, Gomoll AH. The minimal clinically important difference and substantial clinical benefit in the patient-reported outcome measures of patients undergoing osteochondral allograft transplantation in the knee. Cartilage. 2021;12(1):42-50.
69. Lim HC, Park YB, Ha CW, Lee CH, Yoon YC, Jung J, et al. Allogeneic umbilical cord blood-derived mesenchymal stem cell implantation versus microfracture for large, full-thickness cartilage defects in older patients: a multicenter randomized clinical trial and extended 5-year clinical follow-up. Orthop J Sports Med. 2021;9(9):2325967120973052.
70. Solheim E, Hegna J, Inderhaug E. Long-term survival after microfracture and mosaicplasty for knee articular cartilage repair: a comparative study between two treatment cohorts. Cartilage. 2020;11(1):71-6.
71. Chahal J, Lansdown DA, Davey A, Davis AM, Cole BJ. The clinically important difference and patient acceptable symptomatic state for commonly used patient-reported outcomes after knee cartilage repair. Am J Sports Med. 2021;49(1):193-9.
72. Shimomura K, Muneta T, Morito T, Matsumoto K, Tsuji K, Saito H, et al. First-in-human pilot study of implantation of a scaffold-free tissue-engineered construct generated from autologous synovial mesenchymal stem cells for repair of knee chondral lesions. Am J Sports Med. 2018;46(10):2384-93.

Cite this article as: McKinley MT, Oyedemi OO, Childers JT, Mowers CC, Jackson GR, DeFroda SF, et al. Current trends in articular cartilage research: a bibliometric analysis of the 50 most-cited clinical articles over the last 10 years. Int J Res Orthop 2026;12:738-46.