Original Article

Patellar Tendon Injury: A Bibliometric Analysis of the Most-Cited Articles Demonstrates Relatively High Overall Level of Evidence

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Purpose: To identify and analyze the 50 most-cited articles in patellar tendon injury research. **Methods:** The ISI Web of Science and SCOPUS databases were used to conduct a search for articles pertaining to patellar tendon injury. For the top 50 most-cited articles, bibliometric data (title, first and senior author, citation count, journal, publication year, citation density, country of origin, Level of Evidence [LOE]) and topic of article were recorded. **Results:** The mean number of citations was 172.0 ± 88.2 (range 101-546). There was a statistically significant correlation between publication year and citation density ($r = 0.61$, $P < .01$). The earliest article was the third most-cited article (362 citations), published by Blazina et al. in 1973, which discussed the epidemiology of patellar tendinopathy. The first and second most-cited articles (546 and 466 citations, respectively) covered surgical outcomes of patellar tendinopathy and prevalence of patellar tendinopathy among elite athletes. A total of 14 articles (28%) discussed nonoperative management, whereas only 5 articles discussed surgical management (10%). The most frequent LOE category was a LOE of IV (n = 18, 36%), but 19 studies (38%) were LOE I or LOE II. **Conclusions:** Among the top 50 most-cited studies regarding patellar tendon injury, a relatively high number were of a high LOE (19 Level I or II, 38%), affirming that these articles in patellar tendon injury research are not only influential, but also of high-quality evidence. **Clinical Relevance:** This bibliometric analysis provides an efficient tool for educators, researchers, and evidence-based practitioners to identify and evaluate the most influential articles in patellar tendon injury research.

Patellar tendon injury, most frequently manifesting as chronic patellar tendinopathy, is a common cause of anterior knee pain. While acute rupture is straightforward in both diagnosis and indication for surgery, patellar tendinopathy (also known as jumper's knee) can be difficult to diagnose and determine appropriate management. Nonoperative treatment ranges from physical therapy with eccentric quadriceps exercises to injections with corticosteroids, extracorporeal shock wave therapy, and platelet-rich plasma injections.[1-6] Refractory or advanced cases (i.e., Popkin-Golman grade 4 partial patellar tendon tears) are indicated for surgery, which involves arthroscopic or open debridement of pathologic tissue, primary suture or suture anchor repair, or augmentation of the patellar tendon with suture, wire, allograft, or autograft.[7-11]

As with all clinical pathologies, evidence from previous decades has formed the foundation for evidence-based decision making in today's practice. Blazina et al.[12] in 1973 described the "jumper's knee" clinical condition, and the Blazina classification for jumper's knee continues to be used today. In contrast, diagnostic and management status quos are occasionally challenged by more recent evidence, which may reshape the way in which evidence-based practitioners view the clinical condition. An awareness of both initial and modern influential articles is critical. It allows for

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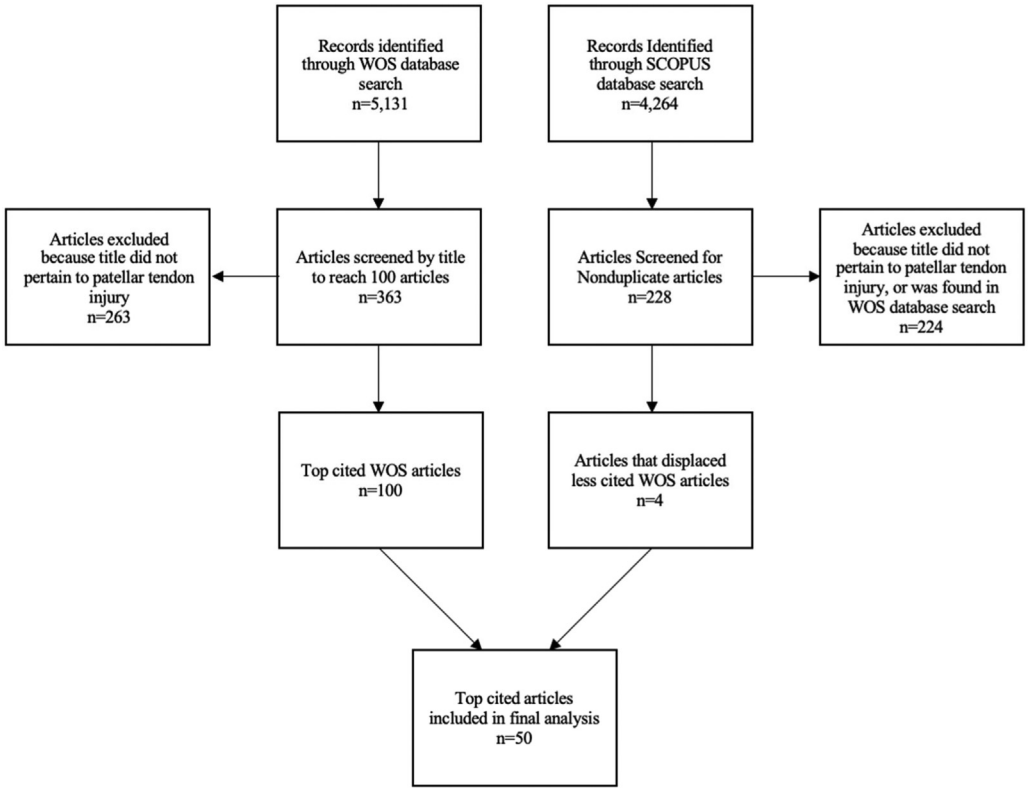

Fig 1. Search algorithm. (WOS, Web of Science.)

observation of important patterns in thought surrounding the clinical pathology, allows more robust evidence-based decision making, and may spark ideas for future research.

Bibliometric analysis is a frequently used tool in the evaluation of the literature surrounding important clinical topics and can be an efficient tool in the arsenal of educators, researchers, and evidence-based practitioners alike. These analyses allow identification and evaluation of the most influential articles, based on total citations and citation density (e.g., citations per year published), within a specific field of study. The value of such analyses is 3-fold. First, bibliometric analyses are useful in medical training, as they allow educators to facilitate creation of efficient reading programs for residents and fellows to cover the most influential articles in a specific field of study. Second, these data are useful for researchers to ensure they are abreast of the most influential previous articles, and identify key evidence that is already available, before designing their own research questions. Finally, these analyses can identify the overall quality (i.e., level of evidence [LOE]) and distribution (i.e., type of study and topic) of influential articles in a given field. Previous bibliometric analyses have demonstrated in many cases that the most-cited articles are not always of the LOE, and have identified specific areas where further impactful research would benefit different fields of medicine.[13]

Bibliometric analyses have been performed in many orthopaedic fields of study within the sports medicine,[13-19] arthroplasty,[20] spine,[21,22] hand,[23] trauma,[24] and foot and ankle[25] subspecialties. In many of these analyses, the majority of the most-cited articles have been of lower LOE (i.e., level III and level IV LOE[24-29]). The purpose of this study is to identify and analyze the 50 most-cited articles in patellar tendon injury research. We hypothesized that in this list of the 50 most-cited articles, the majority would be of Level III or Level IV evidence.

Methods

The ISI Web of Science (WOS) (which includes MEDLINE, BIOSIS Citation Index, Scielo Citation Index, KCI-Korean Journal Database, and Russian Science Citation Index) and SCOPUS databases were used to conduct a search for articles pertaining to patellar tendon injury. Our search was performed on April 1, 2022, and included all articles published up to that date. The Boolean operators used were as follows: (patellar tendon* OR patellar tendin* OR patellar ligament OR jumper's knee OR jumpers' knee) NOT (anterior cruciate ligament OR ACL OR PCL). This search yielded 5,131 articles from WOS (Fig 1). Articles were screened

Table 1. 50 Most-Cited Articles in Patellar Tendon Injury Research, 1973-2015

Rank	Article	Citation Count	Citation Density	LOE
1	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. Victorian Institute of Sport Tendon Study Group. *Scand J Med Sci Sports* 2000;10:2-11.[7]	546	24.82	Review
2	Lian OB, Engebretsen L, Bahr R. Prevalence of jumper's knee among elite athletes from different sports: A cross-sectional study. *Am J Sports Med* 2005;33:561-567.[30]	466	27.41	IV
3	Blazina ME, Kerlan RK, Jobe FW, Carter VS, Carlson GJ. Jumper's knee. *Orthop Clin North Am* 1973;4:665-678.[12]	362	7.39	IV
4	Visentini PJ, Khan KM, Cook JL, Kiss ZS, Harcourt PR, Wark JD. The VISA score: An index of severity of symptoms in patients with jumper's knee (patellar tendinosis). Victorian Institute of Sport Tendon Study Group. *J Sci Med Sport* 1998;1:22-28.[26]	303	12.63	IV
5	Awad HA, Boivin GP, Dressler MR, Smith FN, Young RG, Butler DL. Repair of patellar tendon injuries using a cell-collagen composite. *J Orthop Res.* 2003;21:420-431.[31]	300	15.79	Animal Study
6	Khan KM, Bonar F, Desmond PM, et al. Patellar tendinosis (jumper's knee): Findings at histopathologic examination, US, and MR imaging. Victorian Institute of Sport Tendon Study Group. *Radiology* 1996;200(3):821-827.[32]	288	11.08	IV
7	Kongsgaard M, Kovanen V, Aagaard P, et al. Corticosteroid injections, eccentric decline squat training and heavy slow resistance training in patellar tendinopathy. *Scand J Med Sci Sports* 2009;19:790-802.[1]	235	18.08	I
8	Malliaras P, Barton CJ, Reeves ND, Langberg H. Achilles and patellar tendinopathy loading programmes: A systematic review comparing clinical outcomes and identifying potential mechanisms for effectiveness. *Sports Med* 2013;43:267-286.[33]	209	23.22	IV
9	Kon E, Filardo G, Delcogliano M, et al. Platelet-rich plasma: new clinical application: A pilot study for treatment of jumper's knee. *Injury* 2009;40:598-603.[2]	206	15.85	IV
10	Witvrouw E, Bellemans J, Lysens R, Danneels L, Cambier D. Intrinsic risk factors for the development of patellar tendinitis in an athletic population. A two-year prospective study. *Am J Sports Med* 2001;29:190-195.[34]	190	9.05	II
11	Filardo G, Kon E, Della Villa S, Vincentelli F, Fornasari PM, Marcacci M. Use of platelet-rich plasma for the treatment of refractory jumper's knee. *Int Orthop* 2010;34:909-915.[6]	181	15.08	II
12	Young MA, Cook JL, Purdam CR, Kiss ZS, Alfredson H. Eccentric decline squat protocol offers superior results at 12 months compared with traditional eccentric protocol for patellar tendinopathy in volleyball players. *Br J Sports Med* 2005;39:102-105.[35]	176	10.35	I
13	Zwerver J, Bredeweg SW, van den Akker-Scheek I. Prevalence of jumper's knee among nonelite athletes from different sports: A cross-sectional survey. *Am J Sports Med* 2011;39:1984-1988.[36]	171	15.55	II
14	Jonsson P, Alfredson H. Superior results with eccentric compared to concentric quadriceps training in patients with jumper's knee: A prospective randomised study. *Br J Sports Med* 2005;39:847-850.[37]	169	9.94	I
15	Kettunen JA, Kvist M, Alanen E, Kujala UM. Long-term prognosis for jumper's knee in male athletes. A prospective follow-up study. *Am J Sports Med* 2002;30:689-692.[38]	168	8.40	III
16	Dragoo JL, Wasterlain AS, Braun HJ, Nead KT. Platelet-rich plasma as a treatment for patellar tendinopathy: A double-blind, randomized controlled trial. *Am J Sports Med* 2014;42:610-618.[29]	167	20.88	I
17	Ferretti A. Epidemiology of jumper's knee. *Sports Med* 1986;3:289-295.[39]	167	4.64	Review
18	Peers KH, Lysens RJ. Patellar tendinopathy in athletes: current diagnostic and therapeutic recommendations. *Sports Med* 2005;35:71-87.[40]	155	9.12	Review
19	Cook JL, Khan KM, Harcourt PR, et al. Patellar tendon ultrasonography in asymptomatic active athletes reveals hypoechoic regions: A study of 320 tendons. *Clin J Sport Med* 1998;8:73-77.[41]	153	6.38	III
20	Cook JL, Khan KM, Harcourt PR, Grant M, Young DA, Bonar SF. A cross sectional study of 100 athletes with jumper's knee managed conservatively and surgically. The Victorian Institute of Sport Tendon Study Group. *Br J Sports Med* 1997;31:332-33642	153	6.12	IV
21	Fredberg U, Bolvig L. Significance of ultrasonographically detected asymptomatic tendinosis in the patellar and achilles tendons of elite soccer players: A longitudinal study. *Am J Sports Med* 2002;30:488-491.[43]	151	7.55	IV
22	Bahr R, Fossan B, Loken S, Engebretsen L. Surgical treatment compared with eccentric training for patellar tendinopathy (jumper's knee). A randomized, controlled trial. *J Bone Joint Surg Am* 2006;88:1689-1698.[8]	150	9.38	I

(continued)

Table 1. Continued

Rank	Article	Citation Count	Citation Density	LOE
23	Purdam CR, Jonsson P, Alfredson H, Lorentzon R, Cook JL, Khan KM. A pilot study of the eccentric decline squat in the management of painful chronic patellar tendinopathy. *Br J Sports Med* 2004;38:395-397.[44]	148	8.22	II
24	Rio E, Kidgell D, Purdam C, et al. Isometric exercise induces analgesia and reduces inhibition in patellar tendinopathy. *Br J Sports Med* 2015;49:1277-1283.[45]	145	20.71	I
25	Juncosa-Melvin N, Boivin GP, Gooch C, et al. The effect of autologous mesenchymal stem cells on the biomechanics and histology of gel-collagen sponge constructs used for rabbit patellar tendon repair. *Tissue Eng* 2006;12:369-379.[46]	138	8.63	Animal Study
26	Vetrano M, Castorina A, Vulpiani MC, Baldini R, Pavan A, Ferretti A. Platelet-rich plasma versus focused shock waves in the treatment of jumper's knee in athletes. *Am J Sports Med.* 2013;41:795-803.[28]	137	15.22	I
27	Malliaras P, Cook JL, Kent P. Reduced ankle dorsiflexion range may increase the risk of patellar tendon injury among volleyball players. *J Sci Med Sport* 2006;9:304-309.[47]	137	8.56	IV
28	Lian O, Holen KJ, Engebretsen L, Bahr R. Relationship between symptoms of jumper's knee and the ultrasound characteristics of the patellar tendon among high level male volleyball players. *Scand J Med Sci Sports* 1996;6:291-296.[48]	135	5.19	IV
29	Kelly DW, Carter VS, Jobe FW, Kerlan RK. Patellar and quadriceps tendon ruptures—jumper's knee. *Am J Sports Med* 1984;12:375-380.[49]	135	3.55	IV
30	Kongsgaard M, Qvortrup K, Larsen J, et al. Fibril morphology and tendon mechanical properties in patellar tendinopathy: effects of heavy slow resistance training. *Am J Sports Med* 2010;38:749-756.[50]	134	11.17	II
31	James SL, Ali K, Pocock C, et al. Ultrasound guided dry needling and autologous blood injection for patellar tendinosis. *Br J Sports Med* 2007;41:518-521; discussion 522.[27]	134	8.93	II
32	Fredberg U, Bolvig L, Pfeiffer-Jensen M, Clemmensen D, Jakobsen BW, Stengaard-Pedersen K. Ultrasonography as a tool for diagnosis, guidance of local steroid injection and, together with pressure algometry, monitoring of the treatment of athletes with chronic jumper's knee and Achilles tendinitis: A randomized, double-blind, placebo-controlled study. *Scand J Rheumatol* 2004;33:94-101.[51]	134	7.44	I
33	Khan KM, Maffulli N, Coleman BD, Cook JL, Taunton JE. Patellar tendinopathy: Some aspects of basic science and clinical management. *Br J Sports Med* 1998;32:346-355.[52]	134	5.58	Review
34	Zernicke RF, Garhammer J, Jobe FW. Human patellar-tendon rupture. *J Bone Joint Surg Am* 1977;59:179-183.[53]	132	2.93	IV
35	Alfredson H, Ohberg L. Neovascularisation in chronic painful patellar tendinosis—promising results after sclerosing neovessels outside the tendon challenge the need for surgery. *Knee Surg Sports Traumatol Arthrosc* 2005;13:74-80.[54]	131	7.71	IV
36	Ferretti A, Ippolito E, Mariani P, Puddu G. Jumper's knee. *Am J Sports Med* 1983;11:58-62.[55]	130	3.33	IV
37	Richards DP, Ajemian SV, Wiley JP, Zernicke RF. Knee joint dynamics predict patellar tendinitis in elite volleyball players. *Am J Sports Med* 1996;24:676-683.[56]	128	4.92	IV
38	Cook JL, Khan KM, Kiss ZS, Griffiths L. Patellar tendinopathy in junior basketball players: A controlled clinical and ultrasonographic study of 268 patellar tendons in players aged 14-18 years. *Scand J Med Sci Sports* 2000;10:216-220.[57]	126	5.73	III
39	Visnes H, Bahr R. The evolution of eccentric training as treatment for patellar tendinopathy (jumper's knee): A critical review of exercise programmes. *Br J Sports Med* 2007;41:217-223.[58]	123	8.20	Review
40	Alfredson H. The chronic painful Achilles and patellar tendon: research on basic biology and treatment. *Scand J Med Sci Sports* 2005;15:252-259.[59]	123	7.24	Review
41	Roels J, Martens M, Mulier JC, Burssens A. Patellar tendinitis (jumper's knee). *Am J Sports Med* 1978;6:362-368.[60]	122	2.77	II
42	Malliaras P, Cook J, Purdam C, Rio E. Patellar tendinopathy: Clinical diagnosis, load management, and advice for challenging case presentations. *J Orthop Sports Phys Ther.* 2015;45:887-898.[61]	121	17.29	Review
43	Cadambi A, Engh GA. Use of a semitendinosus tendon autogenous graft for rupture of the patellar ligament after total knee arthroplasty. A report of seven cases. *J Bone Joint Surg Am* 1992;74:974-979.[9]	117	3.90	IV
44	Lian O, Engebretsen L, Ovrebø RV, Bahr R. Characteristics of the leg extensors in male volleyball players with jumper's knee. *Am J Sports Med* 1996;24:380-385.[62]	115	4.42	III
45	Rand JA, Morrey BF, Bryan RS. Patellar tendon rupture after total knee arthroplasty. *Clin Orthop Rel Res* 1989(244):233-238.[63]	115	3.48	IV

(continued)

Table 1. Continued

Rank	Article	Citation Count	Citation Density	LOE
46	Hoksrud A, Ohberg L, Alfredson H, Bahr R. Ultrasound-guided sclerosis of neovessels in painful chronic patellar tendinopathy: A randomized controlled trial. *Am J Sports Med* 2006;34:1738-1746.[4]	114	7.13	I
47	Crossett LS, Sinha RK, Sechriest VF, Rubash HE. Reconstruction of a ruptured patellar tendon with Achilles tendon allograft following total knee arthroplasty. *J Bone Joint Surg Am* 2002;84:1354-1361.[64]	109	5.45	IV
48	Warden SJ, Kiss ZS, Malara FA, Ooi AB, Cook JL, Crossley KM. Comparative accuracy of magnetic resonance imaging and ultrasonography in confirming clinically diagnosed patellar tendinopathy. *Am J Sports Med* 2007;35:427-436.[65]	108	7.20	II
49	Cook JL, Khan KM, Kiss ZS, Coleman BD, Griffiths L. Asymptomatic hypoechoic regions on patellar tendon ultrasound: A 4-year clinical and ultrasound followup of 46 tendons. *Scand J Med Sci Sports* 2001;11:321-327.[66]	107	5.10	II
50	Cannell LJ, Taunton JE, Clement DB, Smith C, Khan KM. A randomised clinical trial of the efficacy of drop squats or leg extension/leg curl exercises to treat clinically diagnosed jumper's knee in athletes: pilot study. *Br J Sports Med* 2001;35:60-64.[67]	101	4.81	I

LOE, Level of Evidence.

consecutively by title, starting with the most-cited article, to exclude articles unrelated to patellar tendon injury. Screening of the first 363 articles resulted in exclusion of 263 unrelated articles, generating a preliminary list of the 100 most-cited articles with possible relation to patellar tendon injury. Next, the 4,264 articles generated from the SCOPUS search were screened consecutively by title starting with the most-cited article. After exclusion of duplicates and unrelated articles from the first 228 articles on the SCOPUS list, an additional 4 articles which were not found in the WOS search qualified for the 100 most-cited list, displacing less-cited articles (Fig 1).

From this list of articles, sorted by descending number of total citations, each article was screened consecutively by abstract and/or full text by 2 independent authors until the 50 most-cited articles in patellar tendon injury research were identified. Articles discussing healthy patellar tendon anatomy, biomechanical properties, or histology without relation to injury were excluded. Country and language of publication did not serve as exclusion criteria. After screening 58 articles, with exclusion of 8 articles that discussed only healthy patellar tendons, the final list of the 50 most-cited articles was formed (Table 1).[30-67] The full texts of these 50 most-cited articles were further analyzed to collect article bibliometric data (i.e., manuscript title, first author, senior author, total citation count, journal of publication, year of publication, citation density since publication, country of origin, LOE). If 2 articles had the same number of citations, citation density since publication was used as a tiebreaker. LOE was determined by one author via the Oxford evidence-based medicine levels of evidence and verified by the senior author. During this time, articles were also categorized by topic. The topics included basic

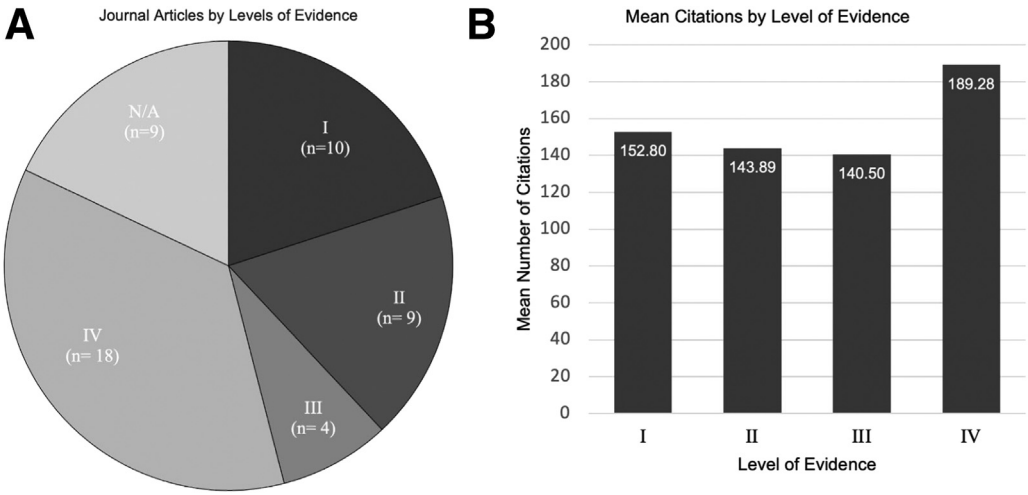

Fig 2. (A) Number of articles published by levels of evidence and (B) mean number of citations per level of evidence.

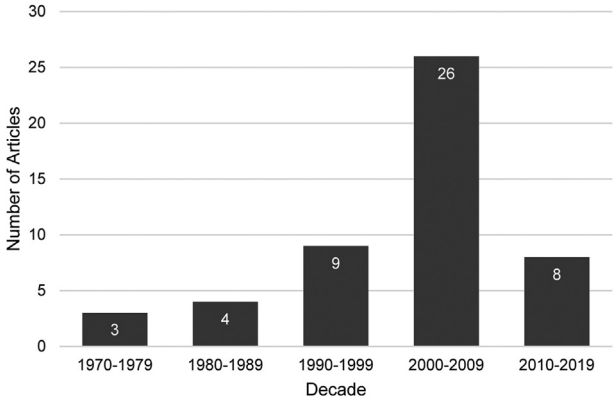

Fig 3. Number of articles by decade.

science and biomechanics, epidemiology and classification, imaging, nonoperative management, surgical management, and comprehensive review.

Categorical variables were reported as counts and continuous variables were reported as means and standard deviation. Shapiro–Wilk test was performed to examine the distribution of individual variables for normality. One-way analysis of variance to was used to compare groups of continuous variables. Bonferroni-adjusted pairwise *t*-tests were performed to analyze any significant differences identified. The Fisher exact test was used to evaluate categorical variables. The Pearson correlation coefficient was used to assess associations between two continuous variables. All analyses were performed with R, Version 4.1.0 (R Foundation for Statistical Computation, Vienna, Austria).

Results

The top 50 most-cited articles in patellar tendon injury research were identified (Table 1). The mean number of citations was 172.0 ± 88.2. The median number of citations was 137.5. The most-cited article was cited 546 times, and 50th most-cited article was cited 101 times. The average citation density since year of publication was 9.9 ± 6.0.

The most frequent LOE category was a LOE of IV (n = 18, 36%). The remaining distribution of articles by LOE can be found in Fig 2A. Eight of the 10 articles graded with a LOE of I were categorized as nonoperative management articles. Articles with a LOE of IV had the highest mean citation number (189.28 ± 100.6), followed by LOE I (152.80 ± 37.44), LOE II (143.89 ± 30.78), and LOE III (140.5 ± 24.31) (Fig 2B). There was no difference in total citation count (F = 2.81, $P = .10$) or citation density (F = 0.37, $P = .55$) between each of the LOE categories.

The publication dates for our list ranged from 1973 to 2015. Of the 5 decades spanned by these articles, 2000-2009 was the most prolific, producing a total of 26 articles (52%). The most prolific individual year was 2005 (6 articles, 12%). Complete data regarding number of articles published by decade can be found in Figure 3. The earliest published article was the third most-cited article (362 citations) on this list, published by Blazina et al. in 1973.[12] Eleven of the earliest 20 articles on this list discussed either "epidemiology and classification" or "basic science and biomechanics." Twelve of the most recent 20 articles on the list discussed "nonoperative management." There was no correlation between year of publication and citations (r = −0.06, $P = .68$); however, there was a statistically significant moderate correlation between year of publication and citation density (r = 0.61, $P < .01$) (Fig 4).

The top 50 cited articles were published from a total of 11 countries. The most prolific country was Australia, with a total of 12 publications (24%), followed by the United States of America, with 10 publications (20%). The rest of the countries in decreasing order include Norway, Italy, Denmark, Belgium, Canada, Sweden, United Kingdom, Finland, and the Netherlands (Fig 5). Several authors served as first or senior author on more than 1 publication, including Bahr (n = 6), Cook (n = 5), Alfredson (n = 4), Khan (n = 4), and Wark (n = 4) (Table 2).

The top 50 articles were published in a total of 17 journals. The most frequent journal of publication was *American Journal of Sports Medicine* (15 articles, 30%), followed by the *British Journal of Sports Medicine* (9 articles, 18%). The remaining journals published at most 6 articles, with 11 journals (22%) publishing only 1 article (Fig 6).

Based on our classification into one of the 6 topics, 14 articles (28%) discussed nonoperative management, whereas only 5 articles discussed surgical management (10%). The next most common topic was epidemiology and classification (n = 11, 22%). Seven articles focused on imaging (14%). Six articles focused on basic science and biomechanics (12%), and another 6 were

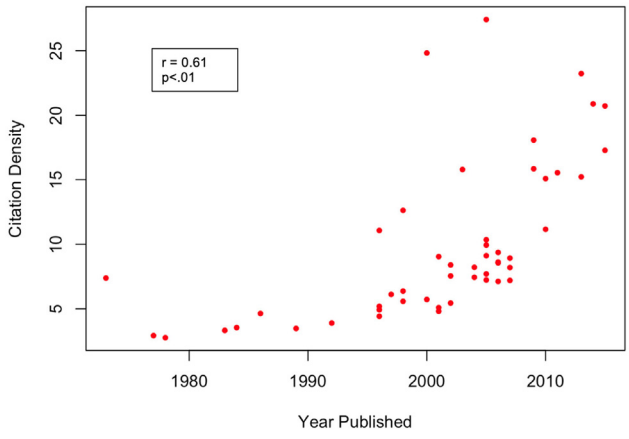

Fig 4. Citation density versus year published.

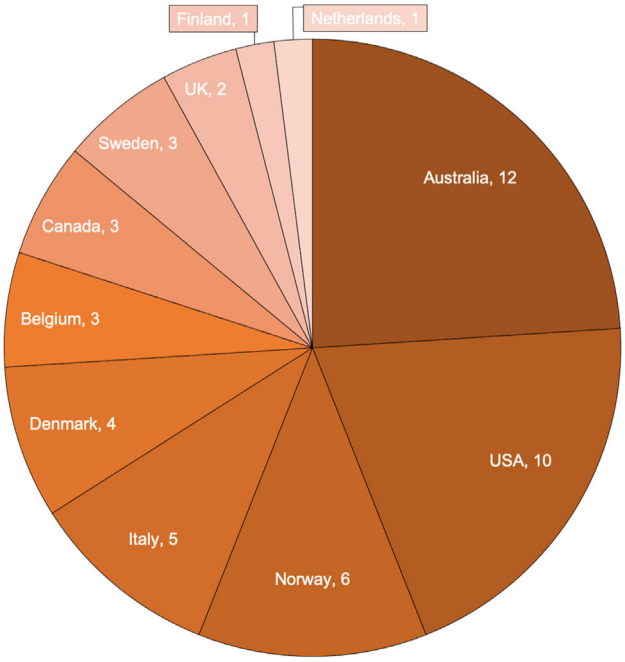

Fig 5. Number of articles published by country of origin.

comprehensive reviews covering multiple aspects related to patellar tendon injury (12%) (Fig 7). There was no difference in total citation count (F = 0.40, $P = .53$) or citation density (F = 1.33, $P = .26$) between each topic

Discussion

The most important finding of this study is that there is a relatively high percentage of Level I and Level II studies (38%) among the top 50 most-cited research articles regarding patellar tendon injury (Fig 2A). This is a far greater proportion of high LOE studies than identified for other orthopedic fields of study.[13,15] This serves as relative affirmation that these articles in patellar tendon injury research are not just influential but also of high-quality evidence. Of the 10 studies with LOE I, 8 of them focused on nonoperative management and covered therapies such as platelet-rich plasma and corticosteroid injections, once again demonstrating the importance clinicians and researchers in this field have placed on evaluating nonoperative therapies. Interestingly, articles with a LOE I had a mean citation count of 152.8 compared with LOE IV, with a mean citation count of 189.28, although there was no statistically significant difference between any of the LOE groups (Fig 2B). One explanation for this is that all articles with a LOE I were published in recent decades (7 in 2000-2009 and 3 in 2010-2019) and thus may not have had the time to accrue citations when compared with earlier articles. Furthermore, it is possible that lower LOE studies that provide epidemiologic and descriptive data may provide the groundwork for a greater volume of future studies due to the breadth of information provided in some cases. Thus, these studies may accrue a higher number of citations.

Two of the most influential articles identified by our analysis were the articles by Blazina et al.[12] and Visentini et al.[26] in 1973 and 1998, respectively. Blazina et al.[12] defined jumper's knee in 1973 as a painful condition of the knee originating from small tears in the patellar tendon, occurring most frequently in sports requiring strenuous jumping such as basketball, volleyball, and track. From this definition, the Blazina classification system for patellar tendinopathy was created. Visentini et al.[26] in their 1990 article "The VISA Score: An index of severity of symptoms in patients with jumper's knee (patellar tendinosis)" (fourth most-cited article, 303 citations) established the VISA-P questionnaire. Visentini et al.[26] demonstrated that VISA-P scores could distinguish between asymptomatic controls, patients with jumper's knee, and patients presurgery for jumper's knee and suggested that the questionnaire could be

Table 2. Number of Articles as First or Senior Author

Author	Country	Number of Articles	Rank of Articles	Mean Citations	Total Citations
Bahr, R.	Norway	6	2, 22, 28, 39, 44, 46	183.8	1,103
Cook, J.L.	Australia	5	19, 20, 24, 38, 49	136.8	684
Alfredson, H.	Sweden	4	12, 14, 35, 40	149.8	599
Khan, K.M.	Australia, Canada	4	6, 23, 33, 50	167.8	671
Wark, J.D.	Australia	4	1, 4, 6, 19	322.5	1,290
Ferretti, A.	Italy	3	17, 26, 36	144.7	434
Lian, O.	Norway	3	2, 28, 44	238.7	716
Malliaras, P.	Australia	3	8, 27, 42	155.7	467
Fredberg, U.	Denmark	2	21, 32	142.5	285
Kongsgaard, M.	Denmark	2	7, 30	184.5	369
Butler, D.L.	U.S.A.	2	5, 25	219.0	438
Griffiths, L.	Australia	2	38, 49	116.5	233
Magnusson, S.P.	Denmark	2	7, 30	184.5	369
Marcacci, M.	Italy	2	9, 11	193.5	387
Rio, E.	Australia	2	24, 42	133.0	266
Zernicke, R.F.	Canada, U.S.A.	2	34, 37	130.0	260

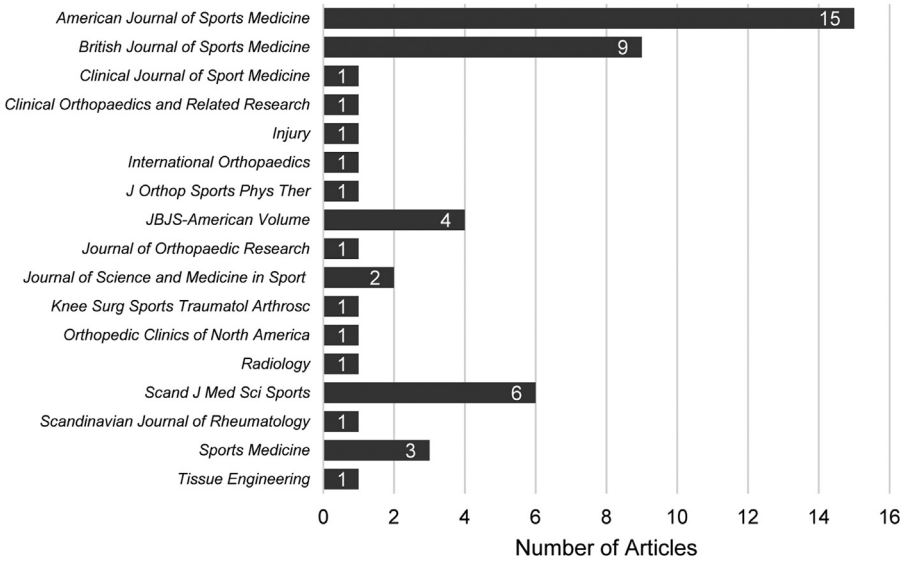

Fig 6. Number of articles published per journal.

used as a standardized diagnostic, classification, and research tool. The VISA-P questionnaire and Blazina classification system continue to be used today, a testament to the impact these articles had on the field.

We observed an association between prevailing topic and time period. When looking at the earliest 20 articles in this list, 11 discussed either "epidemiology and classification" or "basic science and biomechanics." When looking at the prevailing topics for the most recent 20 articles in this list, 12 of them were grouped under "nonoperative management." This may suggest that earlier research was centered on establishing the pathophysiology and clinical presentation of patellar tendinopathy as well as identifying risk factors and isolating the most at-risk populations. The more recent emphasis on nonoperative management, including evaluation of platelet-rich plasma and ultrasound-guided sclerosis, falls much in line with the emphasis placed on nonoperative and minimally invasive management techniques in current orthopedics literature.[2,4,27-29] Nonoperative management also happened to be the most frequently discussed topic overall (n = 14, 28%) (Fig 7).

The articles with the highest citation count in our analysis were "Studies of Surgical Outcome After Patellar Tendinopathy: Clinical Significance of Methodological Deficiencies and Guidelines for Future Studies" with 546 citations by Coleman et al.[7] and "Prevalence of Jumper's Knee Among Elite Athletes From Different Sports—A Cross-Sectional Study" with 466 citations by Lian et al.[30] (Table 1). The article by Coleman et al.[7] critically analyzed the available literature on the surgical treatment of patellar tendinopathy to determine the quality of the studies and merit of conclusions. They found that lower quality studies reported better postoperative outcomes and thus concluded that study methodology may have had a problematic influence on the reporting of surgical

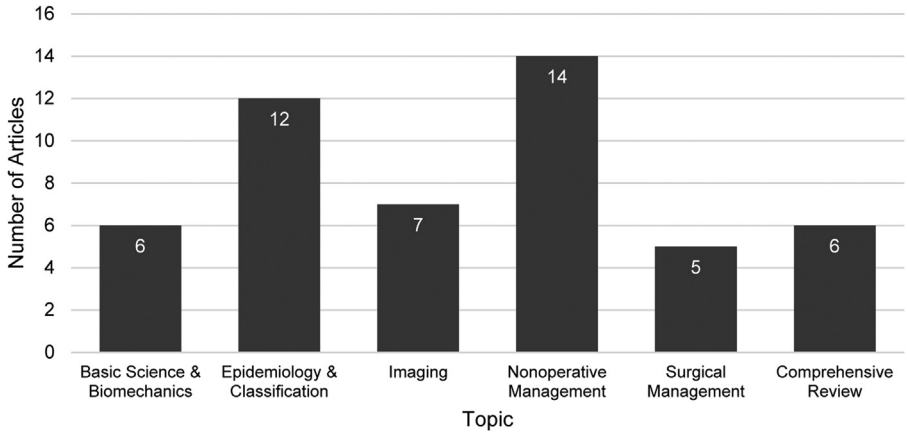

Fig 7. Number of articles by topic.

outcomes in his era.[7] In showing that surgical management was not definitively beneficial, Coleman et al.[7] may perhaps have spurred the aforementioned shift toward further research of nonoperative management. Evaluation of citation density (i.e., citation count divided by years since publication) has been popularized to control for the time advantages that older articles have in accruing citations. In fact, our analysis revealed a moderate correlation between year of publication and citation density ($r = 0.61$, $P < .01$), implying that newer articles have indeed had a relatively greater level of influence when controlling for time since publication (Fig 4). Still, the 2 articles with the highest citation density were the top 2 overall most-cited articles by Lian et al.[30] and Coleman et al.,[7] with citation densities of 27.41 and 24.82, respectively. This stands as further testament to the continued influence of these papers on the field.

When analyzing the articles by journal, 15 (30%) of the most influential patellar tendon injury articles were published in the *American Journal of Sports Medicine*. Another 9 articles (18%) were published in the *British Journal of Sports Medicine* (Fig 6). When evaluating the number of articles published by country, 12 (24%) articles were published in Australia followed by 10 (20%) published in the United States (Fig 5). Interestingly, despite Australia and USA being the most prolific countries overall, the author with the greatest number of articles as first or senior author was Roald Bahr from Norway (6 articles) (Table 2). Bahr was the senior author of the second most-cited article on this list, which provided evidence on the epidemiology of patellar tendinopathy among elite athletes.[30]

Limitations

This study is not without limitation. While a careful strategy was employed when searching for articles in the ISI Web of Science and SCOPUS databases, the possibility that impactful articles were missed because the correct search terms were not inputted exists. In addition, citation numbers, which demonstrate influence and not necessarily quality, can be affected by practices such as self-citations. Furthermore, citation counts can also be influenced by publication in non-indexed journals, textbooks, lectures, or digital media, which the ISI Web of Knowledge does not capture. Finally, the newest articles, which have not had enough time to gather enough citations to be included in this list, will be completely excluded from these types of analyses.

Conclusions

Among the top 50 most-cited studies regarding patellar tendon injury, a relatively high number were of a high LOE (19 Level I or II, 38%), affirming that these articles in patellar tendon injury research are not only influential, but also of high-quality evidence.

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