

The Most-Cited Ankle Arthroplasty Implant Articles

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Abstract

Background: Citation analysis is a useful way of evaluating the impact, importance, and merit of articles within a medical specialty. Our study identified and analyzed the most-cited articles on ankle arthroplasty implants to evaluate their importance in the field of ankle arthroplasty research.

Methods: Using the keywords “ankle arthroplasty” and “ankle replacement” and the search period 1970-2021, we found 3728 articles on ankle arthroplasty implants in the Scopus, Web of Science, and MEDLINE/PubMed databases. We included original articles, reviews, clinical trials, and case reports in the study. We retrieved the 50 most-cited articles published during the time frame and then screened them for studies of specific ankle arthroplasty implants and their postoperative outcomes. We also recorded and analyzed the articles’ subjects, authorship, journals, countries of origin, and years of publication.

Results: The 50 most-cited articles were published between 1983 and 2014, with the majority (33) published between 2000 and 2010. They generated 9012 citations in the literature. The most-cited study accounted for 497 citations; the mean number of citations per article was 180.24 ± 76.24 . Twenty-three (46%) of the articles addressed postoperative outcomes following a specific type of arthroplasty implant. Arthroplasty implant studies accounted for 4726 citations, or 52.4% of the citations of the 50 articles. The most frequently studied arthroplasty implant was STAR (15), followed by Agility (7), Buechel Pappas (5), and Salto (4). STAR accounted for 3311 citations, or 37% of the total citations of the 50 articles.

Conclusion: Ankle arthroplasty research has made great progress in the past 2 decades, particularly in the area of postoperative outcomes of specific ankle implants, but continued research and publication on additional arthroplasty implants should become a priority.

Level of Evidence: Level V, Review Article.

Keywords: ankle arthroplasty, ankle replacement, ankle implant, bibliometric analysis, STAR

Introduction

Since the introduction of ankle arthroplasty in the 1970s,⁴¹ several generations of new arthroplasty implants have been developed, each introducing improvements such as hydroxyapatite coating, minimal bone resection techniques, 3-component design, and cementless fixation.²² These innovations, combined with a growing population in need of ankle replacement, have led to an increase in both procedure volume and research.³⁹

In any field, a large and rapidly expanding body of research can obscure the studies that historically have made the greatest impact. Citation analysis is a useful way to highlight the impact and significance of specific publications and to identify research trends.^{17,44} Although several

bibliometric analyses of the ankle have been conducted previously, none have examined specific types and generations of ankle arthroplasty implants.

This study identified and analyzed the most-cited research on ankle arthroplasty implants and their outcomes in an effort to understand its impact on the field of ankle arthroplasty.

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Methods

Using the keywords “ankle arthroplasty” and “ankle replacement,” we found 5501 articles on ankle arthroplasty implants in our initial search of the Scopus, Web of Science, and MEDLINE/PubMed databases—2203 in Scopus, 1525 in Web of Science, and 1773 in MEDLINE/PubMed. The studies were published between 1970 and July 2021 and included original articles, reviews, clinical trials, and case reports. From the initial pool of 5501, we retrieved the 50 articles with the most citations. We reviewed the articles from most to least cited, analyzing them for title, authorship, subject, journal, country, and year of publication.

We then conducted full-text reviews of each article to select those that studied specific ankle arthroplasty implants. All ankle arthroplasty implants were included in our assessment. We also conducted a subanalysis of outcomes, survivorship, revisions, arthrodesis, and other reoperation of arthroplasty implants. Revision was defined as replacement of any implant component without removal. Arthrodesis was defined as subsequent fusion of the ankle. Other reoperation was defined as any surgery not including revision or arthrodesis.

Results

Table 1 shows the 50 most-cited articles. The number of citations of each article ranged from 112 to 497, with a mean of 180.24 ± 76.24 . In all, the 50 articles were associated with 9012 citations. The average number of citations per article per year from the date of publication through July 2021 ranged from 3 to 36, with a mean of 12 ± 6.20 . The 50 articles were published between 1983 and 2014, with a majority (33) published between 2000 and 2010. Eighteen of the articles originated in the United States; 10 in the United Kingdom; 4 in Canada; 3 each in Denmark, France, Sweden, and Switzerland; 2 in Japan; and 1 each in the Netherlands and New Zealand.

Twenty-three studies investigated outcomes of a specific type of arthroplasty implant (Table 1), and 17 of these were published between 2000 and 2010. Other topics included arthroplasty vs arthrodesis (4), biomechanics (4), foot deformity (2), and tissue engineering (1).

Studies of Arthroplasty Implant Devices

Arthroplasty implant studies accounted for 4726 (52.4%) of the 9012 citations of the 50 most-cited articles. Implants in the top-cited arthroplasty implant articles included STAR (Waldemar LINK, Hamburg, Germany; now distributed by Stryker, Kalamazoo, MI), Agility (DePuy, Warsaw, IN), Buechel Pappas (Endotec, South Orange, NJ), Salto (Integra, Plainsboro, NJ), HINTEGRA (Newdeal SA, Lyon, France), TNK (Nerima, Tokyo Prefecture, Japan), Mobility

(DePuy, Warsaw, IN), and TPR (Thompson-Parkridge-Richards). The most frequently studied implant device was STAR (15), followed by Agility (7), Buechel Pappas (5), Salto (4), HINTEGRA (3), TNK (3), Mobility (2), and TPR (1) (Table 2). Of these 8 implant types, 5 were second-generation devices and 3 were third-generation implants. Second-generation implants were discussed in 31 total studies, accounting for 7462 citations with a mean of 1492 ± 1202 citations per implant. Third-generation implants were discussed in 9 total studies, accounting for 2330 citations with a mean of 777 ± 315 citations per implant. Studies of the STAR implant accounted for 3311 citations, or 37% of the citations of the 50 most-cited articles.

Studies of Implant Survivorship and Complications

Of the 23 articles on ankle arthroplasty implants, 17 were primary studies assessing implant survivorship and complications, leading to 3508 citations (Table 3). Complications included revision, delayed wound healing, fracture, loosening, periarticular bone formation, osteolytic lesions, talar subsidence, and cysts. Follow-up ranged from 2 to 15 years. Ten of the 17 studies focused on STAR implants, leading to 1947 citations. Eight of the 10 STAR implant primary studies included survival analysis of at least 5 years. There were 41 revisions and 9 removals for 538 Agility ankles; 2 revisions and 0 arthrodesis for 50 Buechel-Pappas ankles, with follow-up ranging from 2 to 16 years; 8 revisions and 0 removals for 122 HINTEGRA ankles, with follow-up of 1.6 years; 18 revisions and 6 arthrodeses for 98 Salto ankles; and 174 revisions and 30 arthrodeses for 1060 STAR ankles. There were 6 revisions or arthrodeses for 32 TPR ankles. There were 230 revisions or arthrodeses for 1471 STAR ankles.

Most-Cited Journal and Authors

The most-cited article, with 497 citations, was an article on arthroplasty vs arthrodesis published by Haddad et al²³ in 2007 in the *Journal of Bone and Joint Surgery*. The *Journal of Bone and Joint Surgery—Series A* was the publisher of the greatest share of the 50 articles (13). The most-cited authors were Hintermann and Valderrabano, who coauthored 5 of the 50 articles, including 3 about specific implants. Their articles were associated with 896 citations.

Levels of Evidence

Most of the articles (42 of 50) had a level of evidence of IV. Among the remaining 8 articles, 4 had a level of evidence of V, 2 had a level of evidence of III, 1 had a level of evidence of II, and 1 had a level of evidence of VII. There were 42

Table 1. The 50 Most-Cited Articles on Ankle Arthroplasty and 23 Most-Cited Studies of Implant Devices, by Citation Count, 1970–July 2021.

First Author (Year)	Title	Journal	No. of Citations		Implant Device
			Total	Per Year	
Haddad (2007) ²³	Intermediate and long-term outcomes of total ankle arthroplasty and ankle arthrodesis: a systematic review of the literature	<i>J Bone Joint Surg Am</i>	497	36	Agility, LCS, Buechel-Pappas, TNK, STAR, Salto
Wood (2003) ⁶¹	Total ankle replacement. The results in 200 ankles	<i>J Bone Joint Surg Br</i>	347	19	STAR
Gougoulias (2010) ²⁰	How successful are current ankle replacements? A systematic review of the literature	<i>Clin Orthop Relat Res</i>	301	27	STAR, Agility, Buechel Pappas, HINTEGRA, Salto, TNK, Mobility
Pyeovich (1998) ⁴⁹	Total ankle arthroplasty: a unique design: two to twelve-year follow-up	<i>J Bone Joint Surg Am</i>	291	13	Agility
Knecht (2004) ³⁴	The Agility total ankle arthroplasty: seven to sixteen-year follow-up	<i>J Bone Joint Surg Am</i>	286	17	Agility
Spirt (2004) ⁵⁵	Complications and failure after total ankle arthroplasty	<i>J Bone Joint Surg Am</i>	277	16	Agility
Saltzman (2009) ⁵³	Prospective controlled trial of STAR total ankle replacement versus ankle fusion: initial results	<i>Foot Ankle Int</i>	276	23	STAR
Hintermann (2004) ²⁷	The HINTEGRA ankle: rationale and short-term results of 122 consecutive ankles	<i>Clin Orthop Relat Res</i>	268	16	HINTEGRA
Anderson (2003) ¹	Uncemented STAR total ankle prostheses: three to eight-year follow-up of fifty-one consecutive ankles	<i>J Bone Joint Surg Am</i>	261	15	STAR
Doets (2006) ¹³	Total ankle arthroplasty in inflammatory joint disease with use of two mobile-bearing designs	<i>J Bone Joint Surg Am</i>	233	16	
Bolton-Maggs (1985) ³	Total ankle arthroplasty. A long-term review of the London hospital experience	<i>J Bone Joint Surg Br</i>	228	6	
Wood (2008) ⁶²	Total ankle replacement: medium-term results in 200 Scandinavian Total Ankle Replacements	<i>J Bone Joint Surg Br</i>	216	17	STAR
Valderrabano (2004) ⁵⁸	Scandinavian total ankle replacement: a 3.7-year average followup of 65 patients	<i>Clin Orthop Relat Res</i>	214	13	STAR
Kitaoka (1996) ³³	Clinical results of the Mayo total ankle arthroplasty	<i>J Bone Joint Surg Am</i>	211	8	
SooHoo (2007) ⁵⁴	Comparison of reoperation rates following ankle arthrodesis and total ankle arthroplasty	<i>J Bone Joint Surg Am</i>	210	15	
Henricson (2007) ²⁶	The Swedish Ankle Arthroplasty Register: an analysis of 531 arthroplasties between 1993 and 2005	<i>Acta Orthop</i>	197	14	STAR
Kofoed (2004) ³⁵	Scandinavian Total Ankle Replacement (STAR)	<i>Clin Orthop Relat Res</i>	194	11	STAR

(continued)

Table I. (continued)

First Author (Year)	Title	Journal	No. of Citations		Implant Device
			Total	Per Year	
Kofoed (1998) ³⁷	Ankle arthroplasty for rheumatoid arthritis and osteoarthritis	<i>J Bone Joint Surg Br</i>	178	8	
Daniels (2014) ¹²	Intermediate-term results of total ankle replacement and ankle arthrodesis a COFAS multicenter study	<i>J Bone Joint Surg Am</i>	177	25	Agility, STAR, Mobility, HINTEGRA
Bonnin (2004) ⁵	Midterm results of the Salto Total Ankle Prosthesis	<i>Clin Orthop Relat Res</i>	176	10	Salto
Buechel (2004) ⁸	Twenty-year evaluation of cementless mobile-bearing total ankle replacements	<i>Clin Orthop Relat Res</i>	167	10	
Zaidi (2013) ⁶⁴	The outcome of total ankle replacement: a systematic review and meta-analysis	<i>Bone Joint J</i>	163	20	
Valderrabano (2007) ⁵⁹	Gait analysis in ankle osteoarthritis and total ankle replacement	<i>Clin Biomech</i>	163	12	
Ohgushi (2005) ⁴⁷	Tissue-engineered ceramic artificial joint—ex vivo osteogenic differentiation of patient mesenchymal cells on total ankle joints for treatment of osteoarthritis	<i>Biomaterials</i>	157	10	
Easley (2011) ¹⁴	Results of total ankle arthroplasty	<i>J Bone Joint Surg Am</i>	154	15	
Glazebrook (2009) ¹⁹	Evidence-based classification of complications in total ankle arthroplasty	<i>Foot Ankle Int</i>	151	13	
Conti (2001) ¹⁰	Complications of total ankle replacement	<i>Clin Orthop Relat Res</i>	142	7	
Mann (2011) ⁴³	STAR™ ankle: long-term results	<i>Foot Ankle Int</i>	141	14	STAR
Fevang (2007) ¹⁸	257 ankle arthroplasties performed in Norway between 1994 and 2005	<i>Acta Orthop</i>	141	10	STAR, TPR
Piriou (2008) ⁴⁸	Ankle replacement versus arthrodesis: a comparative gait analysis study	<i>Foot Ankle Int</i>	136	10	
Buechel (1988) ⁹	New Jersey Low Contact Stress Total Ankle Replacement: biomechanical rationale and review of 23 cementless cases	<i>Foot Ankle Int</i>	136	4	
Bonnin (2011) ⁴	The Salto total ankle arthroplasty: survivorship and analysis of failures at 7 to 11 years	<i>Clin Orthop Relat Res</i>	132	13	Salto
Buechel (2003) ⁷	Ten-year evaluation of cementless Buechel-Pappas meniscal bearing total ankle replacement	<i>Foot Ankle Int</i>	131	7	Buechel-Pappas
Valderrabano (2006) ⁶⁰	Sports and recreation activity of ankle arthritis patients before and after total ankle replacement	<i>Am J Sports Med</i>	130	9	

(continued)

Table I. (continued)

First Author (Year)	Title	Journal	No. of Citations		Implant Device
			Total	Per Year	
Myerson (2003) ⁴⁵	Perioperative complications of total ankle arthroplasty	<i>Foot Ankle Int</i>	130	7	Agility
Kim (2009) ³²	Total ankle replacement in moderate to severe varus deformity of the ankle	<i>J Bone Joint Surg Br</i>	129	11	
Hosman (2007) ³⁰	A New Zealand national joint registry review of 202 total ankle replacements followed for up to 6 years	<i>Acta Orthop</i>	128	9	
Newton III (1982) ⁴⁶	Total ankle arthroplasty. Clinical study of fifty cases	<i>J Bone Joint Surg Am</i>	128	3	
Espinosa (2010) ¹⁶	Misalignment of total ankle components can induce high joint contact pressures	<i>J Bone Joint Surg Am</i>	126	11	
Haskell (2004) ²⁴	Ankle arthroplasty with preoperative coronal plane deformity: short-term results	<i>Clin Orthop Relat Res</i>	125	7	
Henricson (2011) ²⁵	10-year survival of total ankle arthroplasties: a report on 780 cases from the Swedish Ankle Register	<i>Acta Orthop</i>	123	12	
Brunner (2013) ⁶	The Scandinavian total ankle replacement long-term, eleven to fifteen-year, survivorship analysis of the prosthesis in seventy-two consecutive patients	<i>J Bone Joint Surg Am</i>	121	15	STAR
Kofoed (1999) ³⁶	Ankle arthroplasty in patients younger and older than 50 years: a prospective series with long-term follow-up	<i>Foot Ankle Int</i>	121	6	
Hobson (2009) ²⁸	Total ankle replacement in patients with significant pre-operative deformity of the hindfoot	<i>J Bone Joint Surg Br</i>	116	10	
Gougoulias (2009) ²²	History and evolution in total ankle arthroplasty	<i>Br Med Bull</i>	115	10	
Wood (2009) ⁶³	A randomised, controlled trial of two mobile-bearing total ankle replacements	<i>J Bone Joint Surg Br</i>	115	10	STAR, Buechel-Pappas
Kotnis (2006) ³⁸	The management of failed ankle replacement	<i>J Bone Joint Surg Br</i>	115	8	
Easley (2002) ¹⁵	Total ankle arthroplasty	<i>J Am Acad Orthop Surg</i>	113	6	STAR, Buechel-Pappas, Agility, TNK
Takakura (1990) ⁵⁶	Ankle arthroplasty. A comparative study of cemented metal and uncemented ceramic prostheses	<i>Clin Orthop Relat Res</i>	113	4	
Hopgood (2006) ²⁹	Ankle arthrodesis for failed total ankle replacement	<i>J Bone Joint Surg Br</i>	112	7	

Table 2. Ankle Implants Studied.

Implant	No. of Studies	No. of Citations	% Top 50	Generation
STAR	15	3311	35	II
Agility	7	1942	20	II
Buechel Pappas	5	1157	12	II
Salto	4	1106	12	III
TNK	3	911	10	II
HINTEGRA	3	746	8	III
Mobility	2	478	5	III
TPR	1	141	1.5	II

original articles, 5 review articles, and 3 systematic reviews. The original articles included 1 randomized controlled trial.

Discussion

Since the introduction of ankle arthroplasty, a variety of new ankle arthroplasty implants have been created and researched.³⁹ The goal of this study was to analyze landmark research on the outcomes of specific types of ankle arthroplasty implants.

Many of the 50 ankle arthroplasty articles we identified were studies of specific ankle arthroplasty implant devices, possibly reflecting the rapid rate of innovation over the past few decades. Ankle arthroplasty was first introduced in the 1970s by Lord and Marotte, who used a ball and socket implant that they based on hip replacement designs.⁴¹ Complication rates were high, and many studies at the time recommended arthrodesis instead of arthroplasty.⁴² For decades afterward, arthrodesis was considered the gold standard for treatment of ankle osteoarthritis.^{31,57} In the meantime, however, second-, third-, and fourth-generation ankle replacement devices were developed, with new designs and techniques that required additional research on safety and efficacy.^{21,22} This may explain the finding that the majority of the 50 articles were studies of outcomes of arthroplasty implants and were published between 2000 and 2010.

The most-cited article in our analysis was a systematic review published by Haddad et al²³ in 2007, nearly 3 decades after the introduction of ankle arthroplasty. The article assessed literature on the relative efficacy of ankle arthroplasty vs arthrodesis published during the time when the topic was still heavily debated. The authors reviewed second-generation implants and found that arthroplasty and arthrodesis had similar scores on the American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot scale,² similar meta-analytic mean results, and similar revision rates. Although ankle arthroplasty historically was associated with poorer postoperative outcomes, the review by Haddad et al²³ seemed to support the conclusion that foot and ankle

surgeons should favor ankle arthroplasty over arthrodesis because arthroplasty gave patients higher ankle mobility.⁵¹ The authors acknowledged at the time that the data were sparse and that comparative studies were needed to strengthen this conclusion.

A prospective multicenter study by Daniels et al, published in 2014, received the third most citations per year in our review. The study built on the research by Haddad et al²³ and performed a comparative analysis of ankle arthroplasty and arthrodesis based on the Canadian Orthopaedic Foot and Ankle Society (COFAS) Prospective Ankle Reconstruction Database. This study had a level of evidence of II. Before it was undertaken, most of our knowledge of the results of ankle arthroplasty came from level IV evidence.²² Daniels et al¹² found that the intermediate-term clinical outcomes of arthroplasty and arthrodesis were similar. However, rates of revision and major complications were higher after ankle replacement. The authors suggested that as prosthetic designs improved, revision and complication rates might also improve.

The market landscape of arthroplasty implant devices is continuously evolving. Most of the second-generation ankle implant devices identified in our bibliometric analysis, including the Buechel-Papas, Agility, and Mobility implants, are no longer used, and only the STAR implant continues to be widely used. Among our 50 studies, the ones that mentioned STAR implants were cited 3311 times, receiving 37% of the citations in our analysis. Furthermore, 10 of the 17 primary arthroplasty implant studies assessed STAR implants. Several newer implants, such as the INFINITY and the INBONE, do not appear in our analysis.^{40,50,52} Future research should assess the influence of studies of these modern implants on the ankle arthroplasty literature.

Our study has several limitations. First, although Scopus, Web of Science, and MEDLINE/PubMed are comprehensive databases, there are other databases such as Embase that might contain works that do not appear in Scopus, Web of Science, and MEDLINE/PubMed. Furthermore, the databases we used contain primarily works written in English, and we may have omitted relevant articles in other languages. Third, this analysis does not account for self-citation. Authors may tend to cite their own articles to increase citation counts, which could skew the analysis. Future study is needed to understand the prevalence of self-citation and its impact on citation counts. Further, citation count is not always the best measure of an article's impact; level of evidence must also be taken into consideration. Finally, certain well-known journals and authors may have a wider reach than others, leading to higher citation counts for those journals and authors. Higher-quality articles by lesser-known journals and authors may have a deflated citation count.

Despite the limitations of bibliometric analysis, citation counts are used to calculate journal impact factors as well as

Table 3. The 17 Most-Cited Studies of Ankle Arthroplasty Implant Outcomes and Survivorship, 1970–July 2021.

First Author (Year)	Title	Device	Outcomes (N)	N	No. of Follow-up Years	Surgery Years	No. of Citations	
							Total	Per Year
Spirit (2004) ⁵⁵	Complications and failure after total ankle arthroplasty	Agility	Revision (30); removal for arthrodesis (1); reoperation any reason (85)	306	2.75	1995-2001	277	16
Knecht (2004) ³⁴	The Agility total ankle arthroplasty: seven to sixteen-year follow-up	Agility	Revision (7); removal for arthrodesis (7); reoperation any reason (46) Peri-implant lucency (89); death (36); subtalar arthritis (22); talonavicular arthritis (17); syndesmosis nonunion (9); amputation, unrelated cause (1)	132	7-16	1984-1994	286	17
Pyeich (1998) ⁴⁹	Total ankle arthroplasty: a unique design: two to twelve-year follow-up	Agility	Revision (4); removal for arthrodesis (1) Pain (24); delayed union of syndesmosis (28); component migration (12 tibial, 9 talar); nonunion of syndesmosis (9)	100	2-12	1984-1993	291	13
Buechel (2003) ⁷	Ten-year evaluation of cementless Buechel-Pappas meniscal bearing total ankle replacement	Buechel-Pappas	Revision (2); removal for arthrodesis (0); meniscal bearing wear (1); talar component subsidence (1) Survival at 10 y: 93.5%	50	2-10	1991-1998	131	7
Hintermann (2004) ²⁷	The HINTEGRA ankle: rationale and short-term results of 122 consecutive ankles	HINTEGRA	Revision (8); removal for arthrodesis (0); talar component migration (2); pain-free (83)	122	1.6	2000-2002	268	16
Bonnin (2004) ⁵	Midterm results of the Salto Total Ankle Prosthesis	Salto	Revision (2); removal for arthrodesis (2); reoperation for any reason (17); survival at 68 mo: 98%	98	2.9	1997-2000	176	10
Bonnin (2011) ⁴	The Salto total ankle arthroplasty: survivorship and analysis of failures at 7 to 11 years	Salto	Revision (18); removal for arthrodesis (6) Survival any reoperation: 65% survival of component revision: 85% Bone cysts (11 patients); fracture of polyethylene (5); unexplained pain (3)	98	7-11	1997-2000	132	13
Wood (2003) ⁶¹	Total ankle replacement. The results in 200 ankles	STAR	Revision or arthrodesis (14); delayed wound healing (5); fracture of a malleolus (9)	200	6.75	1993-2000	347	19
Anderson (2003) ¹	Uncemented STAR total ankle prostheses: three to eight-year follow-up of fifty-one consecutive ankles	STAR	Revision (12); arthrodesis (0) Revision due to loosening (7) and revision due to meniscus fracture (2) Survival at 5 y: 70%	51	3-8	1993-1999	261	15
Wood (2008) ⁶²	Total ankle replacement: medium-term results in 200 Scandinavian Total Ankle Replacements	STAR	Revision (4); arthrodesis (20) Survival at 5 y: 93% Survival at 10 y: 80%	200	7.3	1993-2000	216	17

Table 3. (continued)

First Author (Year)	Title	Device	Outcomes (N)	N	No. of Follow-up Years	Surgery Years	No. of Citations	
							Total	Per Year
Valderrabano (2004) ⁵⁸	Scandinavian total ankle replacement: a 3.7-year average followup of 65 patients	STAR	Revision (14); arthrodesis (0); other reoperation (9) Ballooning bone lysis (3); periarticular hypertrophic bone formation with decreased dorsiflexion and plantar flexion (43)	68	3.7	1994-1998	214	13
Henricson (2007) ²⁶	The Swedish Ankle Arthroplasty Register: an analysis of 531 arthroplasties between 1993 and 2005	STAR	Revision (101) Survival at 5 y: 78% Survival at 5 y after first 30 cases: 86%	531	5	1993-2005	197	14
Kofoed (2004) ³⁵	Scandinavian Total Ankle Replacement (STAR)	STAR	Revision (5); arthrodesis (4); reoperation (9/33 cemented, 1/25 uncemented) Survival at 12 y: 70% cemented, 95% uncemented	58	9.4	1986-1989 (cement) 1990-1995 (no cement)	194	11
Mann (2011) ⁴³	STAR™ ankle: long-term results	STAR	Revision (9); arthrodesis (5); any complications (21); osteolytic lesions (10) Survival at 5 y: 96% Survival at 10 y: 90%	80	9.1	1998-2000	141	14
Brunner (2013) ⁶	The Scandinavian total ankle replacement long-term, eleven to fifteen-year, survivorship analysis of the prosthesis in seventy-two consecutive patients	STAR	Revision (29); arthrodesis (1); aseptic loosening (9); talar subsidence (11); cysts (5) Survival at 10 y: 71% Survival at 14 y: 46%	72	11-15	1996-2000	121	15
Fevang (2007) ¹⁸	257 ankle arthroplasties performed in Norway between 1994 and 2005	STAR (212) and Cemented TPR (32)	Revision or removal (27); revision or removal STAR (21); revision or removal TPR (6) Survival was same for both prostheses Survival at 5 y: 89% Survival at 10 y: 76%	257	4	1994-2005	141	10
Wood (2009) ⁶³	A randomised, controlled trial of two mobile-bearing total ankle replacements	STAR, Buechel-Pappas	Revision or arthrodesis (12/100 Buechel Pappas, 4/100 STAR) Survival at 5 y: 79% Buechel Pappas, 95% STAR) Difference in survival was not statistically significant ($P = .09$)	200	3	2000-2003	115	10

H-index, both widely used measurements for research impact.¹¹ None of these measures are perfect, but they exist to provide an additional objective and quantifiable source of information that can aid in the discussion of what articles, individuals, or topics were most impactful over time. This is the first bibliometric analysis of ankle arthroplasty implants, which have grown in both research and procedure volume over the last few decades. By broadly assessing the literature, our research has identified high-quality articles as well as topics that may be more likely to make an impact within the field.

Conclusion

This study analyzed the most-cited literature on ankle arthroplasty implants according to topic, authors, journals, countries, and citations per year. Ankle arthroplasty research has greatly increased in the past 2 decades, particularly in the area of postoperative outcomes of specific ankle implants, and continued research and publication in additional areas should be a priority in the ankle arthroplasty medical community.

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Ethical approval

Ethical approval was not sought for the present study because the study did not involve patient data.

Declaration of Conflicting Interests

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