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The 100 most cited papers in foot and ankle surgery☆

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ABSTRACT

Background: The number of citations of a paper gives an indication of an article's merit and importance within a medical specialty. We identify and analyse the 100 most cited papers in foot and ankle surgery.
Method: The Science Citation Index Expanded was searched for citations in 15 respected journals containing foot and ankle articles. Papers were analysed for subject, authorship, institution, country and year of publication. The average yearly citation was compared to total number of citations.
Results: 3501 foot and ankle papers were returned. The maximum number of citations was 1084 and the mean was 104. The top 100 papers were published between 1979 and 2007, with the majority published in the last decade. The ankle was the most important anatomical region discussed, and basic science and degenerative disease were popular topics. We found a large discrepancy between the total number of citations with average yearly citation.
Conclusion: Foot and ankle surgery is a young and rapidly developing sub-specialty within orthopaedics. Recently there has been a significant increase in influential papers published. Certain topics are popular indicating their importance within the field. This study highlights important papers in foot and ankle surgery giving an insight into readership.

1. Introduction

Orthopaedics has seen major changes in its delivery and interpretation over the decades. This has been due to the very large volume of research as well as advancement in technology and in particular instrumentation and implants. Since the publication of *Transactions of the American Orthopaedic Association*, over 100 years ago in 1887 [1]. The orthopaedic literature has exponentially increased in volume. Distinct subspecialties with niche areas of specialist interest have emerged over the decades and the tenets and advantages of evidence based medicine are now firmly entrenched in modern orthopaedic practice.

A citation is an acknowledgement of another author's work that has previously been published. The credibility and quality of a paper are often judged by the number of its citations. These citations reflect the importance of the paper within a specific field of medicine, as recognised by the author's peers. The total number of citations per paper has therefore been used as the single most important yardstick in assessing the academic influence of orthopaedic foot and ankle papers [2]. The number of citations influences the validity of the information contained in papers and its relevance and importance in current orthopaedic foot and ankle practice. The frequency of citation also has important implications for the author's credibility and the publishing journal's impact factor [3].

Authors have devised "Top Lists" by examining the total number of citations for various publications within different medical specialties, including critical care [4], general surgery [5] and plastic surgery [6]. Recently, authors have produced such papers for orthopaedic surgery, and also a number of subspecialties, such as paediatric orthopaedics. As of yet, foot and ankle surgery has not been studied with respect to the published papers in this subspecialty.

2. Materials and method

The Institute for Scientific Information (ISI) has collected data on journal citations since 1945. The ISI's current citation system for peer reviewed articles is known as "Science Citation Index Expanded", and this database can be searched using "Web of Science" [7]. In November 2012 information was collected from the 15 most respected journals containing foot and ankle articles (Table 1). The choice of journal was influenced by previous bibliometric studies within orthopaedics [8,9]. Articles not specific to foot and ankle surgery were excluded, and the remaining 100 most frequently cited journals were selected (Table 2). As described by Kelly et al. [3] these selected articles were analysed for subject, authorship,

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Table 1
Journals analysed.

	Journal
1	Acta Orthopaedica
2	Acta Orthopaedica Scandinavica
3	Archives of Orthopaedic and Trauma Surgery
4	Arthroscopy
5	Clinical Biomechanics
6	Clinical Orthopaedics and Related Research
7	Foot & Ankle
8	Foot & Ankle International
9	Journal of Arthroplasty
10	Journal of Bone And Joint Surgery, American Volume
11	Journal of Bone and Joint Surgery, British Volume
12	Journal of Orthopaedic & Sports Physical Therapy
13	Journal of Orthopaedic Research
14	Journal of Orthopaedic Trauma
15	Knee Surgery Sports Traumatology Arthroscopy

institution, country and year of publication. The total number of citations was compared to the average yearly citation for each article.

3. Results

A total of 3501 foot and ankle papers were returned using our methods. The paper with the maximum number of citations was Kitaoka et al. [11], with 1084, with the mean of our top 100 papers citation count being 104. Kitaoka et al.'s paper also had the highest average number of citations at 57 per year. The top 100 papers were published between 1979 and 2007 (Table 2). More than half of the papers (62) were published in the last decade (Table 3).

Papers originated from 14 countries, with the majority originating from the USA (61) as seen in Table 4. There were 77 institutions responsible for publishing articles in the top 100, the University of Iowa being the most prolific (6) followed by Harborview Medical Center (5) (Table 5). Of our top 100 papers only six authors wrote more than one article, all of whom appeared twice on our list (Table 6). Papers were published in 13 journals, 41 appeared in the Journal of Bone and Joint Surgery-American Volume, 16 in Foot & Ankle International and 11 in Clinical Biomechanics (Table 7).

Table 3
Decade of publication.

Rank	Decade	Number of papers
1	00s	62
2	90s	34
3	80s	3
4	70s	1

Table 4
Country of origin.

Rank	Country	Number of papers
1	USA	61
2	Italy	6
3=	Canada	5
3=	Sweden	5
5=	Australia	4
5=	The Netherlands	4
7=	Switzerland	3
7=	UK	3
9=	Denmark	2
9=	Germany	2
9=	Japan	2
12=	Finland	1
12=	France	1
12=	Hungry	1

Table 2
Top 100 articles in foot and ankle surgery.

Rank	Author	Number of citations	Rank	Author	Number of citations	Rank	Author	Number of citations
1	Kitaoka [11]	1084	35	Mosca, VS [45]	101	68	Doets [78]	66
2	Mazur [12]	232	36	Leardini, A [46]	99	69	Kuo [79]	66
3	Sanders, R[13]	221	37	Sirkin [47]	97	70	Mundermann [80]	65
4	Mann [14]	211	38	Williams [48]	96	71	Giannini [81]	65
5	Laaveg [15]	209	39	Nawoczenski [49]	94	72	Martin [82]	64
6	Kannus [16]	207	40	Mueller [50]	93	73	Paoloni [83]	63
7	Bostman [17]	189	41	Knecht [51]	92	74	Coughlin [84]	63
8	Funk [18]	167	42	Ogden [52]	92	75	Kofoed [85]	62
9	Cooper [19]	166	43	Stacoff [53]	92	76	Burnfield [86]	62
10	Bucholz [20]	157	44	Kumai [54]	92	77	Gobbi [87]	61
11	Lentell [21]	151	45	Armstrong [55]	92	78	Buechel [88]	61
12	Gerber [22]	144	46	Redmond [56]	90	79	Clare [89]	61
13	Coester [23]	143	47	Hodge [57]	90	80	Hunt [90]	61
14	Vail [24]	138	48	Shepherd [58]	88	81	Bibbo [91]	60
15	Rozzi [25]	134	49	Chiari [59]	86	82	Giannini [92]	59
16	Sangeorzan [26]	131	50	Tol [60]	86	83	Whittaker [93]	58
17	Wood [27]	129	51	Van Dijk [61]	86	84	Digiovanni [94]	58
18	Ponseti [28]	128	52	Khan [62]	85	85	Gautier [95]	57
19	Ekstrand [29]	128	53	Dobbs [63]	85	86	Bonnin [96]	53
20	Pyevich [30]	125	54	Spirt [64]	84	87	Thomas [97]	53
21	Bernier [31]	122	55	Acevedo [65]	82	88	Button [98]	52
22	Konradsen [32]	122	56	Hintermann [66]	80	89	Fuchs [99]	52
23	Teeny [33]	118	57	Beynnon [67]	80	90	Buechel [100]	51
24	Hopkinson [34]	118	58	Easley [68]	80	91	Pollak [101]	51
25	Mcilroy [35]	116	59	Ohberg [69]	79	92	Baums [102]	50
26	Pfeffer [36]	115	60	Haddad [70]	78	93	Nork [103]	49
27	Georgiadis [37]	113	61	Valderrabano [71]	76	94	Kay [104]	49
28	Anderson [38]	110	62	Coughlin [72]	75	95	Hertel [105]	48
29	Sanders [39]	109	63	Digiovanni [73]	74	96	Vallier [106]	47
30	Hangody [40]	108	64	Roos [74]	74	97	Dobbs [107]	46
31	Kitaoka [41]	108	65	Taranow [75]	72	98	Weening [108]	46
32	Riddle [42]	104	66	Minami [76]	69	99	Bus [109]	46
33	Hoffman [43]	102	67	Ippolito [77]	67	100	Henricson [110]	45
34	Papa [44]	102						

Table 5
Institution.

Rank	Institution	Number of papers
1	University of Iowa Hospitals and Clinics, USA	6
2	Harborview Medical Center, USA	5
3=	Mayo Clinic, USA	3
3=	Istituti Ortopedici Rizzoli, Italy	3
3=	University of Amsterdam, The Netherlands	3
6=	Washington University School of Medicine, USA	2
6=	University of Virginia, USA	2
6=	UMDNJ-New Jersey Medical School, USA	2
6=	St. Alphonsus Regional Medical Center, USA	2
6=	Keller U.S. Army Hospital, USA	2
6=	Florida Orthopaedic Institute, USA	2
6=	University of Calgary, Canada	2
6=	University of Basel, Switzerland	2

Table 6
Authors.

Rank	Author	Number of papers
1=	Buechel	2
1=	Coughlin	2
1=	Dobbs	2
1=	Giannini	2
1=	Kitaoka	2
1=	Sanders	2

Table 7
Journal of publication.

Rank	Journal	Number of papers
1	Journal of Bone And Joint Surgery, American Volume	41
2	Foot & Ankle International	16
3	Clinical Biomechanics	11
4	Clinical Orthopaedics and Related Research	8
5=	Journal of Bone and Joint Surgery, British Volume	6
5=	Journal of Orthopaedic & Sports Physical Therapy	6
7	Foot & Ankle	3
8=	Arthroscopy	2
8=	Journal of Orthopaedic Research	2
8=	Journal of Orthopaedic Trauma	2
11=	Acta Orthopaedica	1
11=	Acta Orthopaedica Scandinavica	1
11=	Knee Surgery Sports Traumatology Arthroscopy	1

The ankle was the most popular anatomical region discussed, accounting for 53 papers. There were 16 publications where specific anatomical location was not specified, with 11 papers concerning both the foot and hindfoot, respectively. The forefoot was poorly represented with only two papers. Basic science (32) was the most popular choice of topic, followed by degenerative changes [31] and trauma [18] (Tables 8 and 9).

Comparison was made between the average number of citations per year and the total number of citations. There were large variations in the rankings. Table 10 shows the top 10 articles by average number of citation compared to their total number of citations. Kitaoka et al. [11] ranked number one for both average and total, and the paper by Sanders et al. was the only other paper to appear in both top ten lists. Eight of the top ten papers by average citation

Table 8
Anatomical position.

Rank	Anatomical position	Number of papers
1	Ankle	53
2	Foot and Ankle	16
3=	Foot	11
3=	Hindfoot	11
5	Midfoot	7
6	Forefoot	2

Table 9
Paper Topics.

Rank	Topic	Number of papers
1	Basic Science	32
2	Degenerative	31
3	Trauma	18
4	Deformity	10
5	Diabetic Feet	5
6	Rating Systems	4

were published in the year 2000. In comparison, the most recent year of publication for the total citation top ten was 1995.

4. Discussion

This list of citations highlights the important papers in the reasonably young and rapidly developing subspecialty of foot and ankle surgery. It does not give us information about the quality of research or influence on clinical practice [10]. It does, however, give an idea of readership. The paper by Kitaoka et al. [11] which described a scoring system for foot and ankle surgery, appears to be the most important, with a total of 1084 citations. This is more than four times the number of its nearest competitor.

Of the most cited papers, more than half (62) were published after the year 2000. This contradicts the findings of Kelly [3] who found that the 1980s was the most important decade for classic orthopaedic papers. Historically there have been proportionally less publications in the field of foot and ankle surgery, which may account for this difference. Fourteen countries contributed to the list. The USA was the leading force with 61 papers. Certain institutions have a good publication record indicating specific areas of interest, again dominated by American institutions such as the University of Iowa, Harbourview Medical Centre and the Mayo Clinic. Previous authors have hypothesised that American authors are biased towards locally published papers when citing references [3,5,111], which may possibly explain our findings. The most popular journal was Journal of Bone and Joint Surgery (American) with 42 papers, indicating its influence as an orthopaedic publication, superseding subspecialty journals such as Foot and Ankle International with 16, which we would regard this as a high impact journal.

Anatomically the ankle joint proved the most common region of interest. This accounted for 53 papers, highlighting the current importance of the joint within the subspecialty. Six papers described ankle ligament injury, with the most common topic being ankle arthroplasty which totalled 15 publications. Interestingly the forefoot proved least common with only two papers, both of which related to hallux valgus deformity. These findings reflect the recent research and developments in foot and ankle surgery with the ankle replacement being a relatively recent and fashionable procedure. Previous authors [2] have shown that the most cited orthopaedic papers describe classification systems or outcome tools. This appears to be the case with our study where the most cited papers were associated with scoring pathology or classifying it. Basic science was the most popular topic of publication with 32 papers, a large proportion of which (11) related to biomechanics; indicating its relevance in foot and ankle surgery. 31 papers were written about degenerative arthritis, once again emphasising the importance of ankle arthroplasty and arthrodoesis in the literature. Surprisingly only 18 publications related to trauma, and only 10 to foot deformity.

We have highlighted the potential flaw of previous authors, who looked solely at total number of citations. This technique would give an unfair bias to the older papers that over time have accumulated a large number of citations but may be of less importance and influence than a more recent paper. By using the average

Table 10
Comparison of average number of citations per year and total citations.

Author	Year of publication	Average number of citations per year	Rank for average	Total citations	Rank for total citation
Kitaoka	1994	57.05	1	1084	1
Haddad	2007	13	2	78	60
Wood	2003	12.9	3	129	17
Redmond	2006	12.86	4	90	46
Coester	2001	11.92	5	143	13
Sanders	1993	11.05	6	221	3
Anderson	2003	11	7	110	28
Khan	2005	10.62	8	85	52
Riddle	2003	10.4	9	104	32
Knecht	2004	10.22	10	92	41

number of citations per year as the yardstick, we believe that a more representative reflection of clinical importance can be attained. The oldest paper by Mazur et al. [12] featured second in the total number of citations but was only 49th in the average number of citations (6.82 per year).

This analysis has demonstrated that in order to attain a large number of citations, it is important to publish papers in the English language as it appears to be the most frequently used literary language in foot and ankle surgery and also to choose a journal with a high impact factor. With continued development and advances in science, the makeup of this list will inevitably change as new research and philosophies are adopted. Currently this provides a fascinating insight into the most influential foot and ankle papers of recent times.

Conflict of interest

I confirm that no authors have any conflicts of interest with regards the production of this manuscript. No authors have personal relationships with other people or organisations that could inappropriately influence this work. There has been no financial benefit to this work.

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