

Review

A historical review of classic articles in surgery field



Xiao Long, M.D.^a, Jiu-Zuo Huang, M.D.^a, Yuh-Shan Ho, Ph.D.^{b,*}

^aDivision of Plastic and Reconstructive Surgery, Peking Union Medical College Hospital, Beijing, People's Republic of China; ^bTrend Research Centre, Asia University, No. 500, Lioufeng Road, Wufeng, Taichung County 41354, Taiwan

KEYWORDS:

Surgery;
Bibliometric;
Top cited articles;
Article life;
Web of science

Abstract

BACKGROUND: Surgery is one of the most rapidly developing specialties in the past century. Diagnostic methods, operation technique, and knowledge of the diseases are changing continuously. In the academic history, lots of classic papers brought advances for surgery. They were accepted and cited numerously by the medical specialists all over the world. Citation analysis reflects the recognition a work has received in the scientific community by its peers.

DATA SOURCES: The articles in the field of surgery have been cited at least 1,000 times since its publication to 2011 were analyzed. By categorizing the publication year, journals, authors, institutions, countries, life citation cycles, level of evidence provided, and characteristics of the topmost articles, we intended to determine what qualities make the articles important to the specialty. The methodology used in this study was based on the Science Citation Index Expanded database of Web of Science from Thomson Reuters. According to Journal Citation Reports of 2011, it indexes 8,336 journals with citation references across 176 Web of Science categories in science edition. Level of evidence of these articles was graded according to the standard provided by Oxford Centre for Evidence-Based Medicine.

CONCLUSION: Totally 36 articles have been cited at least 1,000 times since their publication to the year 2011. According to their citation histories, 35 articles were further evaluated. These topmost articles covered 8 subspecialties of surgery and were published in 17 journals. The publication year varied from 1940 to 1999 and the articles provided different level of evidence, most of which are retrospective studies of case series. Six articles were research articles including animal model, histology analysis, and laboratory research. The others were clinical articles. From the results of citation analysis, the classic articles are not always in top citations. In addition, some of these articles have no citations after several years post their publication. The introduction of a commonly used classification or scoring system is a major factor in propelling citation by other authors. The most cited articles in surgery present their long academic life in spite of their level of evidence and journal impact factor in which they were published.
© 2014 Elsevier Inc. All rights reserved.

* Corresponding author. Tel.: +886-4-2332-3456 ext. 1797; fax: +886-4-2330-5834.

E-mail address: ysho@asia.edu.tw

Manuscript received October 5, 2013; revised manuscript March 23, 2014

The first published paper in the field of surgery might be originated to 1841.¹ Dr John Hunter and Thomas Shute gave the “First course or lecture on physiology and surgery” on May 1, 1841, then published the lecture in *Provincial Medical and Surgical Journal*. In the lecture, they presented several surgical cases that survived or died of operation. Since then,

numerous scientific papers have been published for the purpose of global communication between surgeons,^{2,3} whether orthopedic surgery,^{4,5} pediatric surgery,^{6,7} plastic surgery,^{8,9} neurosurgery,^{10,11} and other specialties.

Number of articles cited was often used as an indicator of their scientific performance. Top cited articles were commonly listed to provide a basic source of information and were usually categorized according to publication year, journal, authors, countries, and institutions.¹² However, the number of citations of an article is not sufficient to show its impact in the research field. Indicators such as numbers of authors cited, numbers of institutions cited, numbers of countries cited, numbers of subject areas cited, citations per year, and total number of citations of a paper to date have been applied to analyze the high-impact papers.¹³ Citation life cycles of highly cited articles are also considered to be important.¹⁴ The citation histories of papers could give more details of the impact characteristics.¹⁵

Classic papers,¹⁶ also called top cited articles¹⁷ or top publications,¹⁸ have been studied in various medical fields in the last decade, such as orthopedic surgery,¹⁹ ophthalmology,²⁰ critical care medicine,²¹ urology,²² pediatric surgical research,²³ occupational medicine,²⁴ periodontology,²⁵ traumatic spinal cord injury,²⁶ trauma,²⁷ anesthesia and pain,²⁸ obstetrics and gynecology,¹² and plastic surgery.²⁹ Scientific specialties have also used the method of bibliometric analysis to evaluate certain operations, for example, wrist arthroscopy,³⁰ breast reconstruction surgery,³¹ and functional neurosurgery.³² Further evaluations have been applied by data mining of the published papers, including levels of evidence in foot and ankle surgery literature,³³ and trend of India's contribution to the field of plastic and reconstructive surgery.³⁴

It has been reported that because of the presence of many most cited papers, there have been influential subsequent advances in molecular biology resulting in helping a great number of people.³⁵ Highly cited articles nevertheless provide an interesting and useful insight into which authors, articles, and topics are influencing the profession over time.³⁶ Furthermore, using classic papers to teach physiology³⁷ and capillary filtration³⁸ were presented. It was also found that Nobelists are consistently highly cited, while only a small percentage of most cited authors won the prize. It would be expected that a large percentage of the latter are elected to national academies of science.³⁹

This article analyzed those articles in the field of surgery in Science Citation Index with at least 1,000 citations since their publication to the year of 2011. In this study, all journal articles with at least 1,000 total citations since publication to 2011 were selected as top cited works and analyzed with regard to citation histories, total citation, citation in 2011, journals, level of evidence, and Web of Science categories.

Methodology

The methodology used in this study was based on the Science Citation Index Expanded (SCI-Expanded) database

of Web of Science from Thomson Reuters. According to Journal Citation Reports (JCR) of 2011, it indexes 8,336 journals with citation references across 176 Web of Science categories in science edition. In total, 199 journals were listed in the Web of Science categories of surgery in 2011. Within the publication years from 1900 to 2011, 1,059,132 documents were published in 326 journals in the Web of Science categories of surgery based on SCI-Expanded (updated on March 29, 2013). Document type of article was further considered. Altogether 740,982 articles were found. Another filter, TC2011, was used to retrieve the articles. The total number of times an article being cited from its publication to the end of 2011 was recorded as TC2011.^{13,40} Articles with TC2011 greater than or equal to 1,000 were selected out as the classic articles. The advantage of this indicator was its invariance, not updating as time goes on.⁴¹ Likewise, C2011, an article's total number of citations in 2011, and C0, an article's total number of citations in its publication year, were employed to characterize the classic articles. The records were downloaded into spreadsheet software, and manipulated using Microsoft Excel 2007. The impact factor (IF2011) of a journal was determined for each document as reported in the JCR 2011.

Because of changes in country names or institution name over the years, some countries were grouped together. The Federal Republic of Germany, Germany Democratic Republic, West Germany, and Germany were grouped together as Germany. The USSR and Russia were also reclassified as Russia. England, Scotland, Northern Ireland, and Wales were grouped together as the United Kingdom.⁴² Articles from Hong Kong published before 1997 were included in the Chinese category.

Each article with TC2011 greater than 1,000 was reviewed and basic information was collected, including authors, year of publication, source journal of the article, institute of the authors and article type (basic science article or clinical article), and level of evidence for clinical articles based on the standard provided by Oxford Centre for Evidence-Based Medicine on March 2009 (<http://www.cebm.net/>).

Results and Discussion

A total of 36 articles published in the Web of Science categories of surgery have been cited at least 1,000 times since their publication until the end of 2011. All these articles' content and their cited life and history were reviewed. The top one is "A rating scale for depression" published in *Journal of Neurology, Neurosurgery and Psychiatry* by Hamilton in 1960.⁴³ The cited history of this article was further analyzed and it was found that although the article was published in a journal related with the surgery specialty, the article was most cited by neurological and psychiatric articles. Thus, the analysis below excludes

Table 1 Top cited articles of surgery (TC2011 > 1,000)

Rank (TC2011)	Rank (C0)	Rank (C2011)	Article
1 (3773)	13 (0)	4 (176)	Pugh, R.N.H., Murrayly, I.M., Dawson, J.L., Pietroni, M.C. and Williams, R. (1973), Transection of esophagus for bleeding esophageal varices. <i>British Journal of Surgery</i> , 60 (8), 646-649.
2 (3458)	5 (2)	3 (203)	Baker, S.P., Oneill, B., Haddon, W. and Long, W.B. (1974), Injury severity score: A method for describing patients with multiple injuries and evaluating emergency care. <i>Journal of Trauma-Injury Infection and Critical Care</i> , 14 (3), 187-196.
3 (2789)	9 (1)	8 (116)	Scoville, W.B. and Milner, B. (1957), Loss of recent memory after bilateral hippocampal lesions. <i>Journal of Neurology, Neurosurgery and Psychiatry</i> , 20 (1), 11-21.
4 (2555)	1 (10)	1 (295)	Hughes, A.J., Daniel, S.E., Kilford, L. and Lees, A.J. (1992), Accuracy of clinical diagnosis of idiopathic Parkinson's disease: A clinicopathological-study of 100 cases. <i>Journal of Neurology, Neurosurgery and Psychiatry</i> , 55 (3), 181-184.
5 (2325)	13 (0)	2 (208)	Harris, W.H. (1969), Traumatic arthritis of hip after dislocation and acetabular fractures: Treatment by mold arthroplasty - An end-result study using a new method of result evaluation. <i>Journal of Bone and Joint Surgery-American Volume</i> , A51 (4), 737-755.
6 (2189)	9 (1)	9 (115)	Morton, D.L., Wen, D.R., Wong, J.H., Economou, J.S., Cagle, L.A., Storm, F.K., Foshag, L.J. and Cochran, A.J. (1992), Technical details of intraoperative lymphatic mapping for early stage melanoma. <i>Archives of Surgery</i> , 127 (4), 392-399.
7 (2099)	13 (0)	12 (96)	Glucksbe, H., Storb, R., Fefer, A., Buckner, C.D., Neiman, P.E., Clift, R.A., Lerner, K.G. and Thomas, E.D. (1974), Clinical manifestations of graft versus host disease in human recipients of marrow from HI-A-matched sibling donors. <i>Transplantation</i> , 18 (4), 295-304.
8 (1665)	5 (2)	31 (17)	Ono, K. and Lindsey, E.S. (1969), Improved technique of heart transplantation in rats. <i>Journal of Thoracic and Cardiovascular Surgery</i> , 57 (2), 225-229.
9 (1656)	13 (0)	21 (61)	Hunt, W.E. and Hess, R.M. (1968), Surgical risk as related to time of intervention in repair of intracranial aneurysms. <i>Journal of Neurosurgery</i> , 28 (1), 14-20.
10 (1623)	13 (0)	35 (1)	Mittal, K.K., Mickey, M.R., Singal, D.P. and Terasaki, P.I. (1968), Serotyping for homotransplantation. XVIII. Refinement of microdroplet lymphocyte cytotoxicity test. <i>Transplantation</i> , 6 (8), 913-927.
11 (1583)	13 (0)	23 (45)	Aaslid, R., Markwalder, T.M. and Nornes, H. (1982), Non-invasive transcranial doppler ultrasound recording of flow velocity in basal cerebral-arteries. <i>Journal of Neurosurgery</i> , 57 (6), 769-774.
12 (1504)	13 (0)	28 (40)	Breslow, A. (1970), Thickness, cross-sectional areas and depth of invasion in prognosis of cutaneous melanoma. <i>Annals of Surgery</i> , 172 (5), 902-908.
13 (1404)	13 (0)	13 (93)	Brooker, A.F., Bowerman, J.W., Robinson, R.A. and Riley, L.H. (1973), Ectopic ossification following total hip-replacement: Incidence and a method of classification. <i>Journal of Bone and Joint Surgery-American Volume</i> , A55 (8), 1629-1632.
14 (1395)	5 (2)	19 (73)	Fisher, C.M., Kistler, J.P. and Davis, J.M. (1980), Relation of cerebral vasospasm to subarachnoid hemorrhage visualized by computerized tomographic scanning. <i>Neurosurgery</i> , 6 (1), 1-9.
15 (1360)	13 (0)	18 (83)	Giuliano, A.E., Kirgan, D.M., Guenther, J.M. and Morton, D.L. (1994), Lymphatic mapping and sentinel lymphadenectomy for breast-cancer. <i>Annals of Surgery</i> , 220 (3), 391-401.
16 (1349)	13 (0)	10 (100)	Gruen, T.A., Mcneice, G.M. and Amstutz, H.C. (1979), Modes of failure of cemented stem-type femoral components: Radiographic analysis of loosening. <i>Clinical Orthopaedics and Related Research</i> , 141, 17-27.
17 (1305)	13 (0)	6 (132)	Insall, J.N., Dorr, L.D., Scott, R.D. and Scott, W.N. (1989), Rationale of the knee society clinical rating system. <i>Clinical Orthopaedics and Related Research</i> , 248, 13-14.
18 (1296)	13 (0)	19 (73)	Gustilo, R.B. and Anderson, J.T. (1976), Prevention of infection in treatment of 1000 and 25 open fractures of long bones: Retrospective and prospective analyses. <i>Journal of Bone and Joint Surgery-American Volume</i> , 58 (4), 453-458.

(continued on next page)

Table 1 (continued)

Rank (TC2011)	Rank (C0)	Rank (C2011)	Article
19 (1280)	13 (0)	5 (147)	Constant, C.R. and Murley, A.H.G. (1987), A clinical method of functional assessment of the shoulder. <i>Clinical Orthopaedics and Related Research</i> , 214, 160-164.
20 (1274)	13 (0)	22 (54)	Mankin, H.J., Dorfman, H., Lippiell, L. and Zarins, A. (1971), Biochemical and metabolic abnormalities in articular cartilage from osteo-arthritic human hips. II. Correlation of morphology with biochemical and metabolic data. <i>Journal of Bone and Joint Surgery-American Volume</i> , A53 (3), 523-537.
21 (1269)	2 (4)	14 (89)	Bradley, E.L. (1993), A clinically based classification system for acute pancreatitis: Summary of the international symposium on acute pancreatitis, Atlanta, GA, September 11 through 13, 1992. <i>Archives of Surgery</i> , 128 (5), 586-590.
22 (1130)	13 (0)	16 (86)	Delee, J.G. and Charnley, J. (1976), Radiological demarcation of cemented sockets in total hip-replacement. <i>Clinical Orthopaedics and Related Research</i> , 121, 20-32
23 (1118)	13 (0)	17 (84)	Fuhrman, S.A., Lasky, L.C. and Limas, C. (1982), Prognostic significance of morphologic parameters in renal cell carcinoma. <i>American Journal of Surgical Pathology</i> , 6 (7), 655-663.
24 (1110)	5 (2)	7 (119)	Fong, Y., Fortner, J., Sun, R.L., Brennan, M.F. and Blumgart, L.H. (1999), Clinical score for predicting recurrence after hepatic resection for metastatic colorectal cancer: Analysis of 1001 consecutive cases. <i>Annals of Surgery</i> , 230 (3), 309-318.
25 (1106)	9 (1)	33 (13)	Zollinger, R.M. and Ellison, E.H. (1955), Primary peptic ulcerations of the jejunum associated with islet cell tumors of the pancreas. <i>Annals of Surgery</i> , 142 (4), 709-723.
26 (1096)	2 (4)	10 (100)	Mulliken, J.B. and Glowacki, J. (1982), Hemangiomas and vascular malformations in infants and children: A classification based on endothelial characteristics. <i>Plastic and Reconstructive Surgery</i> , 69 (3), 412-420.
27 (1089)	4 (3)	30 (20)	Batson, O.V. (1940), The function of the vertebral veins and their role in the spread of metastases. <i>Annals of Surgery</i> , 112, 138-149.
28 (1087)	13 (0)	31 (17)	Clark, L.C. (1956), Monitor and control of blood and tissue oxygen tensions. <i>Transactions American Society for Artificial Internal Organs</i> , 2 (1), 41-48.
29 (1061)	13 (0)	29 (22)	Burke, J.F. (1961), The effective period of preventive antibiotic action in experimental incisions and dermal lesions. <i>Surgery</i> , 50 (1), 161-168.
30 (1058)	13 (0)	15 (87)	Rutherford, R.B., Baker, J.D., Ernst, C., Johnston, K.W., Porter, J.M., Ahn, S. and Jones, D.N. (1997), Recommended standards for reports dealing with lower extremity ischemia: Revised version. <i>Journal of Vascular Surgery</i> , 26 (3), 517-538.
31 (1052)	9 (1)	23 (45)	Kassell, N.F., Torner, J.C., Haley, E.C., Jane, J.A., Adams, H.P. and Kongable, G.L. (1990), The international cooperative study on the timing of aneurysm surgery. Part 1: Overall management results. <i>Journal of Neurosurgery</i> , 73 (1), 18-36.
32 (1032)	13 (0)	27 (42)	Wichterman, K.A., Baue, A.E. and Chaudry, I.H. (1980), Sepsis and septic shock: A review of laboratory models and a proposal. <i>Journal of Surgical Research</i> , 29 (2), 189-201.
33 (1016)	13 (0)	26 (43)	Walker, M.D., Hunt, W.E., Mahaley, M.S., Norrell, H.A., Ransohoff, J. and Gehan, E.A. (1978), Evaluation of BCNU and/or radiotherapy in treatment of anaplastic gliomas: Cooperative clinical trial. <i>Journal of Neurosurgery</i> , 49 (3), 333-343.
34 (1012)	13 (0)	34 (2)	Boyle, W. (1968), An extension of 51Cr-release assay for estimation of mouse cytotoxins. <i>Transplantation</i> , 6 (6), 761-764.
35 (1002)	13 (0)	25 (44)	Neer, C.S. (1972), Anterior acromioplasty for chronic impingement syndrome in shoulder: A preliminary report. <i>Journal of Bone and Joint Surgery-American Volume</i> , A54 (1), 41-50.

C0 = number of citations in publication year; C2011 = number of citations in 2011; TC2011 = number of citations since its publication to 2011.

this article. [Table 1](#) is the list of the other 35 articles within the surgery specialty.

Publication year

The 35 classic articles (TC2011 > 1,000) in the Web of Science categories of surgery were published from 1940 to 1999. [Fig. 1](#) illustrates the distribution of these 35 articles over the years, and their citations per publication (CPP).

The publication output by decade increased and reached a peak in 1970s. The decade with the most articles was the 1970s, which had 11 articles (31% of 35 classic articles). The 2 most productive years were 1968 and 1982 with 3 articles published, respectively. No classic articles have been found in the decade before the 1940s, and no classic articles have yet emerged in the decade of 2010s. It has indeed been noted that the recent articles need time to accumulate citations.³⁵ In particular, the decade of 1970s with 11 articles

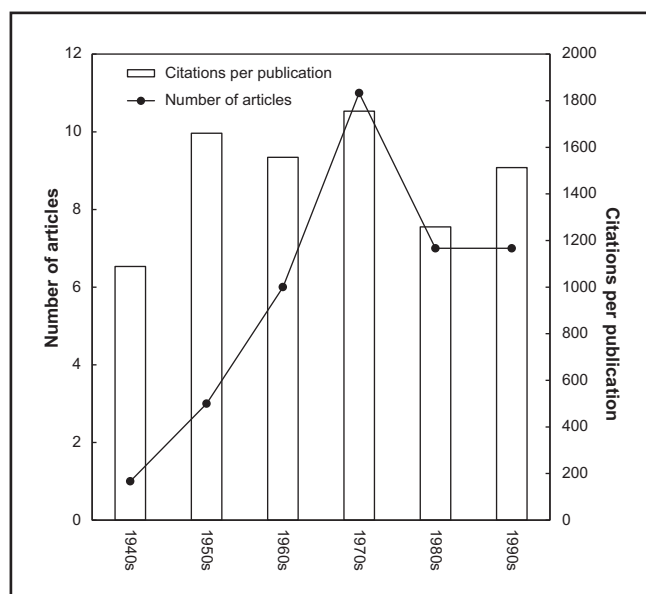


Figure 1 Number of classic articles and citations per publication by decade.

had highest CPP as 1,755, which are mostly attributed by the article of Pugh et al in 1973⁴⁴ with a TC2011 of 3,773 and the article of Baker in 1974⁴⁵ with a TC2011 of 3,458.

Subspecialty

TC2011 not only shows the impact of these classic articles, but also demonstrates the population of medical staffs who were involved in the related specialty. The number of articles sorted by their specialty was led by orthopedic surgery, followed by general surgery and neurosurgery. Fig. 2 shows that 9 articles (48% of articles

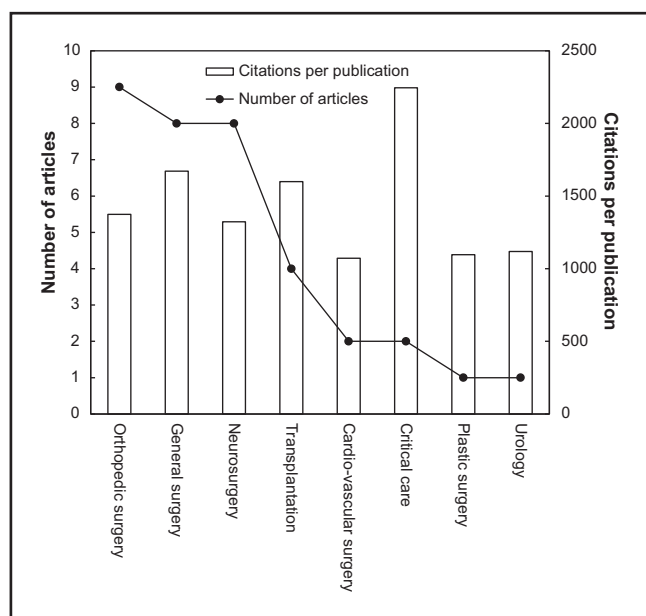


Figure 2 Number of classic articles categorized by the subspecialty.

identified) were published in orthopedics, 8 articles (23%) in general surgery, and 8 articles (23%) in neurosurgery. It also demonstrates that although fewer classic articles were published in critical care, these articles have higher citations on average than other subspecialties.

Level of evidence

In recent years, the level of evidence has gained more attention because it provided the readers the reliability of scientific work.^{46–48} Most of the classic articles ($n = 113$) provided level IV evidence as case series. Level of evidence reflects the relative risk of bias in a study, but not necessarily its inherent quality. One article provided level I clinical evidence, 8 articles provided level II evidence, 13 with level IV evidence, and 7 with level V evidence. The remaining 6 articles were within the basic research area. Articles that provide new methods of operations^{44,49–53} or the proper operation timing^{54,55} are of great importance in the literature history. In spite of the level of evidence, the articles that establish a classification or scoring system for diseases have a tendency to be cited more, as 10 of the 35 most cited articles relate.^{45,56–64}

Authors, institutions, and countries

The results of author analysis have identified those researchers who have made significant contributions. Among the 110 authors contributing to 35 classic articles in the Web of Science categories of surgery, 2 authors published 2 classic articles. Dr Donald L. Morton in the St. John's Hospital and Health Center published 2 articles as "Lymphatic mapping and sentinel lymphadenectomy for breast-cancer"⁵¹ with TC2011 = 1,360 and "Technical details of intraoperative lymphatic mapping for early stage melanoma"⁴⁹ with TC2011 = 2,189. The other author who published 2 classic articles was Dr William E. Hunt from the Department of Surgery, Ohio State University College of Medicine. Dr Hunt published "Evaluation of BCNU and/or radiotherapy in the treatment of anaplastic gliomas: a cooperative clinical trial"⁶⁵ with TC2011 = 1,016 and "Surgical risk as related to time of intervention in repair of intracranial aneurysms"⁵⁴ with TC2011 = 1,656.

Altogether, 35 classic articles originated from 44 institutions including 20 (45% of 44 institutions) universities and 24 nonuniversity institutions (55%). University of California, Los Angeles of the United States published 4 articles which included 2 first author articles followed by Ohio State University of the United States, St. John's Hospital and Health Center of the United States, Massachusetts General Hospital of the United States which published 2 first author articles, respectively. Harvard Medical School, University of Minnesota, and University of Wisconsin of the United States also published 2 articles but had only 1 first author articles, respectively. However, the most frequently cited article was published by King's

College Hospital and Medical School of United Kingdom. Twenty-five articles (71%) came from independent institutions and 10 articles (29%) from interinstitutional collaborations, of which (14%) 9 were national collaborations. The interinstitutional collaboration rate was smaller in some medical subspecialties, for example, 12% of 100 top cited articles in general surgical journals⁶⁶ and 8% of 100 ophthalmology class citations.²⁰

A total of 110 authors from 44 institutions in 4 countries including the United States, the United Kingdom, Canada, and Switzerland published these 35 most cited articles. Top articles usually originated from a small field centered in a few countries.⁴¹ It was reported that in medical-related studies, 100 top cited articles in general surgery journals were produced by 6 countries⁶⁶ and top 100 most frequently cited articles in anesthetic journals originated from 9 countries.⁶⁷

The leading country was the United States (29 articles), accounting for 83%, followed by United Kingdom (4 articles), Canada (2 articles), and Switzerland (1 article). It was not surprising that United States took the lead with an overwhelming majority, which is paralleled by the reports of citation classics in general surgery (78%),⁶⁶ ophthalmology (86%),²⁰ urology, and its subspecialties (76%).²² Only 1 article (3.0%) contributed by the United States and Canada was internationally collaborated, and all the other 34 (97%) articles were single country articles. It was generally accepted that collaboration played an important role in enhancing the impact of articles.^{68,69} In addition, highly cited papers typically involve more collaborative research than the general norm.⁷⁰ However, international collaboration was not obvious for the classic articles in the surgery field. But for the national collaboration, there is 1 interinstitutionally co-operated article in the 1950s and 3 in 1970s, 1980s, and 1990s, respectively. The only international collaborative article finished by most institutions (6 universities), "Recommended standards for reports dealing with lower extremity ischemia: Revised version", was published in 1997.⁶⁴ There is a trend of more collaboration articles among these classic articles in more recent years.

Citation character

The publication years of the most cited articles span from 1940 to 1999, with 1970s accounting for the most articles with 11 (Fig. 1). The 35 most cited articles were published in 17 different journals. The impact factors of these journals vary from 1.394 to 7.492 according to the 2011 JCR. Some of the journals covered multiple medical areas, for example, *Journal of Neurology, Neurosurgery and Psychiatry*. Most of the journals are related with all subspecialties of surgery, such as *Surgery, Annals of Surgery, Archives of Surgery, British Journal of Surgery, and Journal of Surgical Research*. The *Annals of Surgery* and *Journal of Bone and Joint Surgery-American Volume* published most articles (Table 2). There is no lineage relationship between the impact factor and the article number

these journals published. Similarly, the articles could be found in journals with lower impact factors (IF2011 < 1) in the top cited research works in the SCI-Expanded.⁷¹

There are some issues related to the searching and category method of this article. First, publish time is an impact issue because none of the articles in 2000s has been cited at least 1,000 times, while most of the top cited articles are published in the 1970s. Usually an article will gain little attention during the first year after its publication, while the citing number accumulates gradually after several years. Second, a total of 1,059,132 documents in 199 journals listed in the Web of Science categories of surgery in 2011 were reviewed by the authors, which ensure the integrity of our data. There are some journals related to multiple specialties such as *Journal of Neurology, Neurosurgery and Psychiatry*; thus, we further evaluate the content and citation history of all the 36 classic articles with TC2011 > 1,000, and exclude 1 article having little relation with surgery. Third, there are multiple classification systems of the level of evidence and there is no conclusion as to which is the best grading system for evidence until now. This article chose the system provided by Oxford Centre for Evidence-Based Medicine in March 2009 and it is reported to be the most reproducible.⁷² The level of evidence has only been reviewed in few of the other citation analysis which showed the same dominance of level IV and V studies in orthopedic and plastic surgery.^{19,29} A majority of clinical, rather than basic science, articles was also noted in other reviews.^{29,66,67,73}

Table 2 Journals with the most cited papers in surgery

Journal	Number of articles	IF2011
Annals of Surgery	5	7.492
Journal of Bone and Joint Surgery-American Volume	5	3.272
Clinical Orthopaedics and Related Research	4	2.533
Journal of Neurosurgery	4	2.965
Journal of Neurology, Neurosurgery and Psychiatry	3	4.764
Transplantation	3	4.003
Archives of Surgery	2	4.422
American Journal of Surgical Pathology	1	4.352
British Journal of Surgery	1	4.606
Journal of Surgical Research	1	2.247
Journal of Thoracic and Cardiovascular Surgery	1	3.406
Journal of Trauma-Injury Infection and Critical Care	1	2.478
Journal of Vascular Surgery	1	3.153
Neurosurgery	1	2.785
Plastic and Reconstructive Surgery	1	3.382
Surgery	1	3.103
Transactions of the American Society for Artificial Internal Organs	1	N/A

N/A = not available in 2011 (Transactions American Society for Artificial Internal Organs was not in Science Citation Index after 1984).

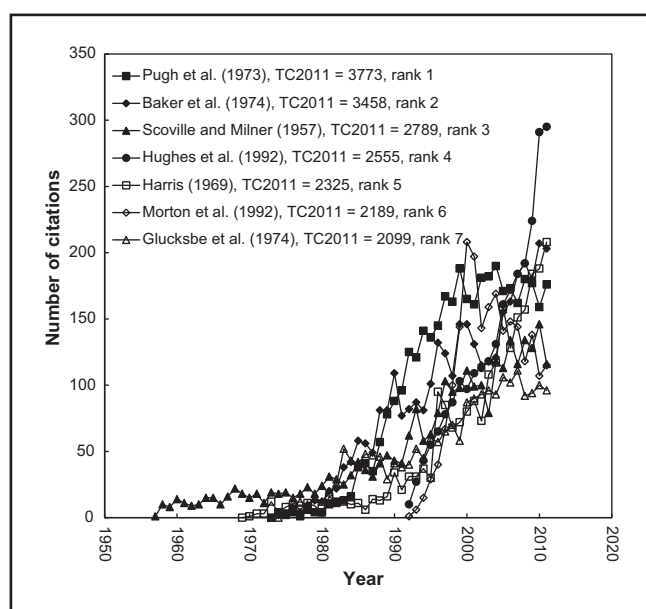


Figure 3 Citation life cycles of the top 7 articles (TC2010 > 2,000).

The articles with the highest TC2011 can be considered the most popular articles in the research field. Article impact histories have been studied with the citation life cycles.^{14,70} The citation lives of the top 7 classic articles (TC2011 > 2,000) are shown in Fig. 3. Five of these 7 articles were published before 1980s, while the other 2 were published in 1992, respectively. It has been noted that the article's impact might not necessarily be high.⁴¹ Only the latter article "Accuracy of clinical diagnosis of idiopathic Parkinson's disease: a clinical-pathological study of 100 cases" by Hughes et al⁷⁴ showed a continually and sharply increasing citation trend in all years since publication.

TC2011 is an accumulative number that may reach a large value as long as the time span is long enough.⁴¹ It is necessary to study the citations of an article cited within every single year to interpret the research focus transfer in recent years. Fig. 4 shows the citation history of the top 6 articles with C2011 > 130. Except the article by Hughes et al,⁷⁴ all the others had low citations in the first 10 or 20 years after their publications. The article "Traumatic arthritis of hip after dislocation and acetabular fractures - treatment by mold arthroplasty - an end-result study using a new method of result evaluation" by Harris⁵⁶ had low annual citations (<20) for 21 years after its publication, but gained 208 citations in 2011 and ranked the second in C2011. Similarly, the article "A clinical method of functional assessment of the shoulder" by Constant and Murley⁵⁹ had no citation for the first 9 years but reached 147 citations in 2011. In comparison with the other articles in Fig. 4, these latter 2 did not have enough time to accumulate citations, but they had high impact in recent years. On the contrary, the article "Serotyping for homotransplantation. XVIII. refinement of microdroplet lymphocyte cytotoxicity test" by Mittal et al⁷⁵ ranked 10th in TC2011, which had significant increase in citations for the first 10 years since its publication, reaching 128 annual

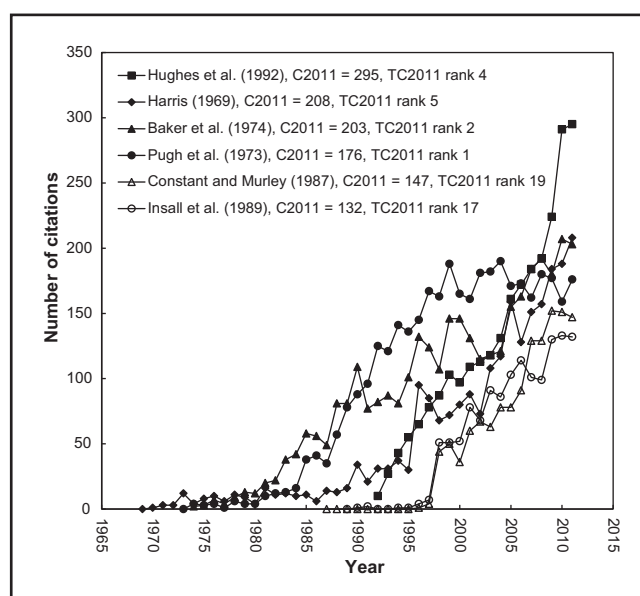


Figure 4 Citation life cycles of the top 6 articles (C2010 > 130).

citations in 1977 and then decreased to 0 citations in 2007 and only 1 citation in 2011.

Conclusions

The 35 classic articles in surgery field were cited an average total of 1,546 times (ranging from 1,002 to 3,773 total citations), based on results for the years from 1940 to 1999. The decade with the most articles and their CPP was 1970s. The specialty of orthopedic surgery published the most articles. Most of the classic articles provided level IV evidence as case series. The 35 classic articles were published by 110 authors in 44 institutions of 4 countries including 45% universities and 55% nonuniversity institutions. University of California, Los Angeles of the United States ranked top 1 with 4 classic articles, while the United States published 83% of classic articles. The 35 classic articles were published in 17 journals including journals with IF2011 < 1. From the results of citation analysis, the classic articles are not always in top citations. In addition, some of these articles have no citations after several years post-publication. The introduction of a commonly used classification or scoring system is a major factor in propelling citation by other authors. The most cited articles in surgery present their long academic life in spite of their level of evidence and impact factor of the journal in which they were published.

References

1. Hunter J. The first course of lectures on physiology and surgery: delivered at St. George's hospital. *Prov Med Surg J* 1841;2:81-4.
2. Bristow RE, Tomacruz RS, Armstrong DK, et al. Survival effect of maximal cytoreductive surgery for advanced ovarian carcinoma during the platinum era: a meta-analysis. *J Clin Oncol* 2002;20:1248-59.

3. Buchwald H, Avidor Y, Braunwald E, et al. Bariatric surgery: a systematic review and meta-analysis. *JAMA* 2004;292:1724–37.
4. Hoffa A. The development and the problems of orthopaedic surgery. *Deut Med Wochenschr* 1902;28:333–5.
5. Mcwhirter JP, Pennington CR. Incidence and recognition of malnutrition in-hospital. *Br Med J* 1994;308:945–8.
6. Coe HE. Symposium on pediatric surgery. *Pediatrics* 1948;1:771–98.
7. Mangram AJ, Horan TC, Pearson ML, et al. Guideline for prevention of surgical site infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. *Am J Infect Control* 1999;27:97–132.
8. Wolf J. The handling of the rectal stricture injuries - together an article regarding plastic surgery of the rectum. *Deut Med Wochenschr* 1900;26:95–8.
9. Tessier P. The definitive plastic surgical treatment of severe facial deformities of craniofacial dysostosis. Crouzon's and Apert's diseases. *Plast Reconstr Surg* 1971;48:419.
10. Dowman CE. Local anesthesia in neurosurgery - with special reference to its value in evulsion of the sensory root in the Gasserian ganglion. *J Am Med Assoc* 1920;74:382–5.
11. Molyneux AJ, Kerr RS, Yu LM, et al. International subarachnoid aneurysm trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised comparison of effects on survival, dependency, seizures, rebleeding, subgroups, and aneurysm occlusion. *Lancet* 2005;366:809–17.
12. Brandt JS, Downing AC, Howard DL, et al. Citation classics in obstetrics and gynecology: the 100 most frequently cited journal articles in the last 50 years. *Am J Obstet Gynecol* 2010;203:355.e1–7.
13. Chuang KY, Wang MH, Ho YS. High-impact papers presented in the subject category of water resources in the essential science indicators database of the institute for scientific information. *Scientometrics* 2011;87:551–62.
14. Aersa ES. Citation patterns of highly cited papers and their relationship to literature aging - a study of the working literature. *Scientometrics* 1985;7:383–9.
15. Wang MH, Li J, Ho YS. Research articles published in water resources journals: a bibliometric analysis. *Desalin Water Treat* 2011;28:353–65.
16. Garfield E. Highly cited articles .26. Some classic papers of late 19th and early 20th centuries. *Curr Contents* 1976;21:5–9.
17. Bentler PM. On the fit of models to covariances and methodology to the bulletin. *Psychol Bull* 1992;112:400–4.
18. Korevaar JC, Moed HF. Validation of bibliometric indicators in the field of mathematics. *Scientometrics* 1996;37:117–30.
19. Lefavre KA. 100 most cited articles in orthopaedic surgery. *Clin Orthop Relat Res* 2011;469:1487–97.
20. Ohba N, Nakao K, Isashiki Y, et al. The 100 most frequently cited articles in ophthalmology journals. *Arch Ophthalmol* 2007;125:952–60.
21. Rosenberg AL, Tripathi RS, Blum J. The most influential articles in critical care medicine. *J Crit Care* 2010;25:157–70.
22. Hennessey K, Afshar K, Macneily AE. The top 100 cited articles in urology. *Can Urol Assoc J* 2009;3:293–302.
23. Celayir S, Sander S, Elicevik M, et al. The most commonly cited articles in pediatric surgical journals. *Eur J Pediatr Surg* 2008;18:160–3.
24. Gehanno JF, Takahashi K, Darmoni S, et al. Citation classics in occupational medicine journals. *Scand J Work Environ Health* 2007;33:245–51.
25. Nieri M, Saletta D, Guidi L, et al. Citation classics in periodontology: a controlled study. *J Clin Periodontol* 2007;34:349–58.
26. Furlan JC, Fehlings MG. A web-based systematic review on traumatic spinal cord injury comparing the “citation classics” with the consumers' perspectives. *J Neurotrauma* 2006;23:156–69.
27. Ollerton JE, Sugrue M. Citation classics in trauma. *J Trauma* 2005;58:364–9.
28. Terajima K, Aneman A. Citation classics in anaesthesia and pain journals: a literature review in the era of the internet. *Acta Anaesthesiol Scand* 2003;47:655–63.
29. Loonen MP, Hage JJ, Kon M. Plastic Surgery Classics: characteristics of 50 top-cited articles in four Plastic Surgery Journals since 1946. *Plast Reconstr Surg* 2008;121:320e–7e.
30. Fernandes CH, Meirelles LM, Raduan Neto J, et al. Characteristics of global publications about wrist arthroscopy: a bibliometric analysis. *Hand Surg* 2012;17:311–5.
31. Moghimi M, Fathi M, Marashi A, et al. A scientometric analysis of 20 years of research on breast reconstruction surgery: a guide for research design and journal selection. *Arch Plast Surg* 2013;40:109–15.
32. Lipsman N, Lozano AM. Measuring impact in stereotactic and functional neurosurgery: an analysis of the top 100 most highly cited works and the citation classics in the field. *Stereotact Funct Neurosurg* 2012;90:201–9.
33. Zaidi R, Abbassian A, Cro S, et al. Levels of evidence in foot and ankle surgery literature: progress from 2000 to 2010? *J Bone Joint Surg Am* 2012;94:e1121–10.
34. Sreekar H, Dawre S, Lamba S, et al. Trend of India's contribution to the field of plastic and reconstructive surgery. *Ann Plast Surg* 2012;69:223.
35. Picknett T, Davis K. The 100 most-cited articles from JMB. *J Mol Biol* 1999;293:171–6.
36. Smith DR. Citation indexing and highly cited articles in the Australian Veterinary Journal. *Aust Vet J* 2008;86:337–9.
37. Raff H. Using classic papers to teach physiology. *Adv Physiol Educ* 2005;29:141–3.
38. McGeown JG. Passing on the legacy: teaching capillary filtration and developing presentation skills using classic papers. *Adv Physiol Educ* 2006;30:108–12.
39. Garfield E, Welljamsdorff A. Of nobel class - a citation perspective on high-impact research authors. *Theor Med* 1992;13:117–35.
40. Wang MH, Yu TC, Ho YS. A bibliometric analysis of the performance of water research. *Scientometrics* 2010;84:813–20.
41. Fu HZ, Wang MH, Ho YS. The most frequently cited adsorption research articles in the Science Citation Index (Expanded). *J Colloid Interface Sci* 2012;379:148–56.
42. Chiu WT, Ho YS. Bibliometric analysis of homeopathy research during the period of 1991 to 2003. *Scientometrics* 2005;63:3–23.
43. Hamilton M. A rating scale for depression. *J Neurol Neurosurg Psychiatry* 1960;23:56–62.
44. Pugh RN, Murray-Lyon IM, Dawson JL, et al. Transection of esophagus for bleeding esophageal varices. *Br J Surg* 1973;60:646–9.
45. Baker SP, O'Neill B, Haddon Jr W, et al. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974;14:187–96.
46. Heath GW, Parra DC, Sarmiento OL, et al. Evidence-based intervention in physical activity: lessons from around the world. *Lancet* 2012;380:272–81.
47. Cartwright N. A philosopher's view of the long road from RCTs to effectiveness. *Lancet* 2011;377:1400–1.
48. Birken CS, Parkin PC. In which journals will pediatricians find the best evidence for clinical practice? *Pediatrics* 1999;103:941–7.
49. Morton DL, Wen DR, Wong JH, et al. Technical details of intraoperative lymphatic mapping for early stage melanoma. *Arch Surg* 1992;127:392–9.
50. Breslow A. Thickness, cross-sectional areas and depth of invasion in the prognosis of cutaneous melanoma. *Ann Surg* 1970;172:902–8.
51. Giuliano AE, Kirgan DM, Guenther JM, et al. Lymphatic mapping and sentinel lymphadenectomy for breast cancer. *Ann Surg* 1994;220:391–8; discussion, 398–401.
52. Neer 2nd CS. Anterior acromioplasty for the chronic impingement syndrome in the shoulder. 1972. *J Bone Joint Surg Am* 2005;87:1399.
53. Ono K, Lindsey ES. Improved technique of heart transplantation in rats. *J Thorac Cardiovasc Surg* 1969;57:225–9.
54. Hunt WE, Hess RM. Surgical risk as related to time of intervention in repair of intracranial aneurysms. *J Neurosurg* 1968;28:14–20.

55. Kassell NF, Torner JC, Haley Jr EC, et al. The International Cooperative Study on the Timing of Aneurysm Surgery. Part 1: Overall management results. *J Neurosurg* 1990;73:18–36.
56. Harris WH. Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am* 1969;51:737–55.
57. Insall JN, Dorr LD, Scott RD, et al. Rationale of the Knee Society clinical rating system. *Clin Orthop Relat Res* 1989;248:13–4.
58. Brooker AF, Bowerman JW, Robinson RA, et al. Ectopic ossification following total hip replacement. Incidence and a method of classification. *J Bone Joint Surg Am* 1973;55:1629–32.
59. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res* 1987;214:160–4.
60. Bradley 3rd EL. A clinically based classification-system for acute pancreatitis. Summary of the International Symposium on Acute Pancreatitis, Atlanta, Ga, September 11 through 13, 1992. *Arch Surg* 1993;128:586–90.
61. Fong Y, Fortner J, Sun RL, et al. Clinical score for predicting recurrence after hepatic resection for metastatic colorectal cancer: analysis of 1001 consecutive cases. *Ann Surg* 1999;230:309–18; discussion, 318–21.
62. DeLee JG, Charnley J. Radiological demarcation of cemented sockets in total hip replacement. *Clin Orthop Relat Res* 1976;121:20–32.
63. Mulliken JB, Glowacki J. Hemangiomas and vascular malformations in infants and children: a classification based on endothelial characteristics. *Plast Reconstr Surg* 1982;69:412–20.
64. Rutherford RB, Baker JD, Ernst C, et al. Recommended standards for reports dealing with lower extremity ischemia: revised version. *J Vasc Surg* 1997;26:517–38.
65. Walker MD, Alexander Jr E, Hunt WE, et al. Evaluation of BCNU and/or radiotherapy in the treatment of anaplastic gliomas. A cooperative clinical trial. *J Neurosurg* 1978;49:333–43.
66. Paladugu R, Schein M, Gardezi S, et al. One hundred citation classics in general surgical journals. *World J Surg* 2002;26:1099–105.
67. Baltussen A, Kindler CH. Citation classics in anesthetic journals. *Anesth Analg* 2004;98:443–51.
68. Narin F, Stevens K, Whitlow ES. Scientific cooperation in Europe and the citation of multinationally authored papers. *Scientometrics* 1991;21:313–23.
69. Packer AL, Meneghini R. Articles with authors affiliated to Brazilian institutions published from 1994 to 2003 with 100 or more citations: I - the weight of international collaboration and the role of the networks. *An Acad Bras Cienc* 2006;78:841–53.
70. Aksnes DW. Characteristics of highly cited papers. *Res Eval* 2003;12:159–70.
71. Ho YS. The top-cited research works in the Science Citation Index Expanded. *Scientometrics* 2013;94:1297–312.
72. Atkins D, Eccles M, Flottorp S, et al. Systems for grading the quality of evidence and the strength of recommendations I: critical appraisal of existing approaches The GRADE Working Group. *BMC Health Serv Res* 2004;4:38.
73. Tsai YL, Lee CC, Chen SC, et al. Top-cited articles in emergency medicine. *Am J Emerg Med* 2006;24:647–54.
74. Hughes AJ, Lee CC, Chen SC, et al. Accuracy of clinical-diagnosis of idiopathic Parkinsons-disease - a clinicopathological study of 100 cases. *J Neurol Neurosurg Psychiatry* 1992;55:181–4.
75. Mittal KK, Mickey MR, Singal DP, et al. Serotyping for homotransplantation. 18. Refinement of microdroplet lymphocyte cytotoxicity test. *Transplantation* 1968;6:913–27.