



# Classic publications and scientometrics in orthopaedics

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Orthopédie (orthopaedics), a French term coined by seventeenth-century physician Nicholas Andry de Bois-Regard derived from the Greek words ὀρθός (orthos; correct or straight), and παιδίον (paidion; child) has shown substantial advances over the past decades. Many subspecialties have appeared and evolved, with significant progress in clinics, as well as in basic science and research [1–6]. Consequently, high-volume orthopaedic surgeons have contributed to high-volume journals with a significant number of high-quality clinical and research papers [4, 7–9]. Since its foundation in 1977, International Orthopaedics, the official journal of Société Internationale de Chirurgie Orthopédique et de Traumatologie (SICOT) has a 43-year publication history of offering a significant contribution to this field of medicine through its numerous high-quality papers. Each year, the journal receives >3000 high-quality paper submissions for consideration; of that number, approximately 400 of the highest-quality papers qualify for publication; the number of times a paper is cited is widely used to measure a journal's scientific impact, as well the impact of the paper and the publishing authorship [8, 10–12].

Bibliometric analyses map the literature around a specific field of research and provide variables with respect to the citations numbers, which are the citations count, subject matter and type, country and institution of origin, and authorship of the published papers [13, 14]. Such analyses provide insights into which type of articles represent the highest academic impact. In these analyses, classic papers that are articles that have attained a classic status in the orthopaedic heritage have been identified.

## The classic papers

By definition, a classic is an excellent model that was judged over a period of time to be of the highest quality and outstanding of its kind. In medical writing, a classic paper is a highly cited publication; it is a model paper that has stood the test of time to be of recognized and established value, having a great impact on the field, and influencing research, education, practice, and opinions [15, 16]. In orthopaedics, a classic paper is highly cited paper and provides an exceptional insight into the history and development of practice. Classic papers have made long lasting and game changing contributions to clinical practice and research, having long term visibility after publication. They highlight the topics that have made the most impact on the clinical practice and provide a fascinating account of the qualities and of the authors achievements. They inspire surgeons to evaluate and eventually change their standard practice, to recognize key advances and significant developments in orthopaedics, to provide an important message, and/or to add a useful prospective on historical developments. Definitely, a classic paper is not about playing a numbers game or a citation quotient; in contrast, it embraces the most in orthopaedic specialty [16, 17].

The top-100 list of classic papers is dominated by protein biochemistry literature. The 1951 paper describing the Lowry method for quantifying protein remains practically unreachable at number 1 classic paper with more than 305000 citations [18]. In orthopaedics, prosthetic surgery of the hip has shown the greatest level of interest [17, 19], with highly cited papers such as the Brooker et al. paper for the ectopic ossification of the hip [20]. In musculoskeletal oncology, typical example of classic papers are the Enneking et al. papers for the surgical staging of musculoskeletal sarcomas and the functional classification of reconstructions after tumors resections [21, 22].

## The citations

Citations (referencing), in which one paper refers to earlier works, are the standard means by which authors acknowledge

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the source of their methods, ideas and findings, and are often used as a rough measure of a paper's importance. After publishing his papers on evaluation of science by citation metrics [23] Eugene Garfield founded in 1956, the Institute for Scientific Information (ISI), located in Philadelphia, Pennsylvania. ISI formed a major part of the science division of Thomson Reuters. In 2016 Thomson Reuters sold its intellectual property and science division to Clarivate Analytics.

In the current way of measuring science citations are very important. A citation is an alphanumeric expression that acknowledges the relevance given by the author to the work of others on a topic of discussion in which the citation appears. The primary objective of a citation is to credit other authors with ideas and innovations about which they have previously published. It is an act of intellectual honesty at the opposite of plagiarism and citations fraud [17].

However, citations are often biased; <20% of the cited papers are actually read by the authors; 3–60% (mean, >20%) of citations have errors; citations are often chosen for convenience rather than for appropriateness; easily available papers such as open access papers and papers written in English language are most often cited; and >25% of citations are standard references such as classic papers. To avoid citations biases, citations should be chosen by the quality of the cited papers, and not by social factors, exchange authorship, or strategic considerations [24, 25].

It is unclear how a paper becomes a classic especially acknowledging the fact that citation counts are biased with confounding factors. In the current era, many rankings and alternative metrics are available including scholar and social metrics. These incorporate search engines that trace citations from a much greater (although poorly characterized) literature base, including books, websites, papers and meeting proceedings [26].

## Measuring a citations classic paper

A classic paper is cited almost without thinking about it. Therefore, measuring the classic status of a paper by the number of times the paper is cited is one approach to meeting this definition [27, 28]. A citations classic paper is identified by the Science Citation Index (SCI) or its larger version, the Science Citation Index Expanded (SCIE), the Social Sciences Citation Index (SSCI), or the Arts & Humanities Citation Index (A&HCI). The journals indexed by the SCIE and SSCI citations indexes are described as the world's leading journals.

The larger version of the Science Citation Index (Science Citation Index Expanded) covers more than 8,500 notable and significant journals, across 150 disciplines, from 1900 to the present. The index is made available online through different platforms, such as the [Web of Science](#) and [SciSearch](#). This

database allows a researcher to identify which later articles have cited any particular earlier article, or have cited the articles of any particular author, or have been cited most frequently. Subsets of this database are also available, termed "Specialty Citation Indexes" such as the Neuroscience Citation Index and the Chemistry Citation Index. The Social Sciences Citation Index (SSCI) is a citation index originally developed by the [Institute for Scientific Information](#) from the [Science Citation Index](#). It is currently a commercial citation index product of [Clarivate Analytics](#). It is a multidisciplinary index that covers more than 3,000 social science journals across 57 disciplines in the social sciences from 1988 to present. The Arts & Humanities Citation Index (A&HCI), also known as Arts & Humanities Search, is a citation index, with abstracting and indexing for more than 1800 arts and humanities journals across 28 arts and humanities disciplines. Part of this database is derived from Current Contents records. Subjects covered are the Arts, Humanities, Language (including Linguistics), Poetry, Music, Classical works, History, Oriental Studies, Philosophy, Archaeology, Architecture, Religion, Television, Theater, and Radio. Available citation (source) coverage includes articles, letters, editorials, meeting abstracts, errata, poems, short stories, plays, music scores, excerpts from books, chronologies, bibliographies and filmographies, as well as citations to reviews of books, films, music, and theatrical performances. This database can be accessed online through [Web of Science](#). It provides access to current and retrospective bibliographic information and cited references. It also covers individually selected, relevant items from approximately 1,200 titles, mostly arts and humanities journals but with an unspecified number of titles from other disciplines.

There is an argument of whether citation analysis that is measuring the numbers (count and density) of citations should be considered as a significant influence on what constitutes a classic paper [16, 29, 30]. For scientific research, the impact factor of a journal has become a controversial area of debate with critics for a number of faults and manipulations. The citations count is an alternative to rank an article, authors and journals; the more cited an article, the greater the impact factor of the journal and the more renowned the authors they become. The citations density is determined by the number of citations over the number of years a work has been published. It allows for the relative impact of an article regardless of year of publication; however, although a recently published article may have a high citation density because of its newness it usually takes a few years to acquire classic status [16]. Additionally, citations numbers do not account for self-citations, citations in textbooks and lectures; there is a clear temporal effect in citation analysis with the most recent articles being at a disadvantage, there is an obvious bias in favor of English language journals and journals included in

computerized databases, and older publications are no longer cited with the same frequency because their findings become incorporated into the body of current knowledge or they become so familiar that they do not need a citation (the “obliteration by incorporation” phenomenon) [13, 17, 31–35]. Last, the numbers of citations are influenced by confounding factors that preclude their use as a measure of quality of the research and its influence on current literature and clinical practice. These include the types of publications, the time of publication, the size and field of the study, the journal in which the article is published, and the novelty of a subspecialty. Publication of randomized trials, meta-analyses and basic science reports may lead to significantly more citations than other study types [36].

### Publishing a citations classic paper

Citation rates differ for each discipline. The number of citations indicating a classic in an orthopaedic subspecialty might be lower than the number required to make it a classic in a larger field of orthopaedics specialty. In general, a publication cited more than 400 times should be considered a classic; but in some fields with fewer researchers, 100 citations might qualify a classic work. Obviously, review articles, introductory articles, editorials, guidelines, commentaries, and articles with less than 20 citations are excluded from any list of classic papers. Many methodological papers become a standard reference that one cites to make clear the kind of work and methodology. Articles that present tools for outcome evaluation or provide classification systems usually result in the most overall citations because these are commonly used in the methodologies of other research studies [37]. Publishing in the English language, and in high impact factor journals are important factors to be considered for a classic paper.

Currently, citation analysis, although biased and idiosyncratic is the best method we have to assess the degree of peer analysis, readership, recognition, importance and impact of the paper, the authors and the publishing journal [13, 17, 31, 33–35, 38, 39]. Formulating a method to allow the use of citation analysis to measure scientific quality and to be counted without biases would be ideal.

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