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Original article

# The top 100 most-cited *Orthopaedics & Traumatology: Surgery & Research* articles

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ABSTRACT

*Background:* The French peer-reviewed journal *Revue d'Orthopédie* founded on 1st January 1890 extended its scope in 2009 by creating the English-language, online-only, indexed journal *Orthopaedics & Traumatology: Surgery & Research* (OTSR). Bibliometric data help authors and readers assess the citation potential of articles published in a given journal. We found no bibliometrics for the first 10 years of OTSR. The objectives of this bibliometric study were to identify (i) the 100 most-cited OTSR articles and (ii) the specialties or article types most often involved in citations.
*Methods:* The Scopus database was used to determine the citation rates of the 2158 articles published in OTSR during the journal's first 10 years. A bibliometric analysis was performed on the 100 most-cited articles.
*Results:* Mean time since publication of the 100 most-cited articles was 6.60 ± 1.66 years (range: 2–10 years) and mean number of citations per article was 49.59 ± 24.16 (range: 30–169). Mean number of citations per year was 7.75 ± 3.26 (range: 4–18.78) and mean number per author was 5.52 ± 3.14 (range: 1–21). The first author was French in 89/100 cases. Of the 100 articles, 56 were based on a multicentre study and 21 on an international study. Finally, 22/100 articles reported studies sponsored by a scientific society.
*Discussion:* The 100 articles identified in this study deserve to be viewed as influential. The number of citations will continue to rise, thereby amplifying the impact of OTSR on worldwide research in orthopaedic surgery.
*Level of evidence:* IV, systematic retrospective analysis.


## 1. Introduction

France has nearly 2900 orthopaedic surgeons according to board-of-physician statistics, and about 60% of its over 67 million inhabitants will undergo at least one orthopaedic surgical procedure during their lifetime [1]. French orthopaedic surgery has been a pioneer in many areas including bone defect management, the development of novel arthroplasty techniques, and internal fixation [2–14].

The French peer-reviewed *Revue d'Orthopédie* founded on 1 January 1890 broadened its reach in 2009 by creating the English-language indexed journal *Orthopaedics & Traumatology: Surgery & Research* (OTSR). The scope of OTSR encompasses basic scientific research, orthopaedic surgery of the upper and lower limbs, traumatology, spinal surgery, hand surgery, paediatric surgery, and oncology. The article types include original articles, some of which report studies sponsored by scientific societies for their symposia; systematic literature reviews; consensus conference reports; meta-analyses; and technical notes. Case-reports were published only until 2017. The number of citations per article varies considerably, from 0 to 2640 [15]. Citation numbers depend not only on the content of the article, i.e., on the new information provided, but also on its form. Although OTSR has now been in existence for 10 years, to our knowledge no bibliometric analyses have been performed

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to provide authors and readers with information about citation potential.

The objectives of this bibliometric study were to identify:

- the 100 most-cited OTSR articles;
- the specialties or article types most often involved in citations.

## 2. Material and methods

### 2.1. Material

We examined the 2158 articles published in OTSR and indexed between February 2009 and December 2018 (https://www.journals.elsevier.com/orthopaedics-and-traumatology-surgery-and-research).

### 2.2. Methods

On 11 December 2018, we searched the Scopus database for citations of the 2158 OTSR articles. On the same day, we used the academic citation analysis freeware Publish or Perish (version 6.40.6326, released on 31 October 2018, created by Prof. Anne-Wil Harzing), with Google Scholar as the publication retrieval tool [16,17]. Citations in English and several other languages were sought. Our reference classification tool was Scopus, which directly indexes articles from over 5000 publishers, and not the open web. Scopus has the major advantage of supplying links to full-text articles, with no or only very few duplicates.

#### 2.2.1. Measurement methods

The OTSR articles were classified according to number of citations retrieved by Scopus then by decreasing year of publication. As performed in earlier studies [18–21], basic information including the title, authors, and publication year were recorded. The number of citations per year, number of authors, and number of citations per author were computed.

The 100 most-cited articles were identified and examined. For these articles, the following were recorded: country of the first author, single-centre or multi-centre design, country of origin of the authors, abstract word count, level of evidence, whether the study was sponsored by a scientific society, and the subspecialty of the study. Finally, the 100 articles were classified based on annual number of citations.

### 2.3. Statistical analysis

The statistical analysis was performed using Excel™ (Microsoft, Redmond, WA, USA) and Addinsoft (2019) XLSTAT™ statistical and data analysis solution. (Long Island, NY, USA) https://www.xlstat.com. Quantitative variables were described as mean ± SD (range). Linear regression was used to assess the number of citations according to article classification. The Shapiro–Wilk test was chosen to evaluate distribution. Means were compared by applying Student's *t*-test when distribution was normal and the non-parametric Wilcoxon test otherwise. There were no missing data, as all the articles were fully analysed.

## 3. Results

The 100 most-cited OTSR articles are shown in Appendix 1. Mean time since publication of the 100 most-cited articles was 6.60 ± 1.66 years (range: 2–10 years). Mean values were as follows: citations per article, 49.59 ± 24.16 (range: 30–169); citations per year, 7.75 ± 3.26 (range: 4–18.78); authors per article, 5.52 ± 3.14 (range: 1–21); citations per author, 12.46 ± 13.89 (range: 2.5–126); title words, 13.36 ± 4.81 (range: 4–24); and abstract words, 308.99 ± 83.86 (range: 92–496). Appendix 2 shows the classification of the articles by annual citation number.

**Table 1**
100 most-cited OTSR articles: mean number of citations by level of evidence.

| Level of evidence | Number of articles | Mean number of citations | *p*-value |
|---|---|---|---|
| Review articles | 19 | 49.32 | 0.96 |
| II | 8 | 40.50 | 0.16 |
| III | 14 | 50.21 | 0.88 |
| IV | 51 | 52.16 | 0.60 |
| V | 3 | 47.00 | – |
| Technical notes | 2 | 36.50 | – |
| Cadaver study | 1 | 40.00 | – |
| Lecture | 1 | 37.00 | – |
| Animal study | 1 | 44.00 | – |

OTSR: *Orthopaedics & Traumatology: Surgery & Research*.

The first author was French for 89/100 articles. A multi-centre design was used in 56/100 cases and a single-centre design in the remaining 44/100 cases. The authors worked in more than one country in 21/100 cases; the other countries involved were China, *n* = 3; Belgium, *n* = 2; Germany, *n* = 1; Greece, *n* = 1; India, *n* = 1; Portugal, *n* = 1; Switzerland, *n* = 1; the UK, *n* = 1; the USA, *n* = 1; and a combination of countries, *n* = 9.

Levels of evidence were as follows: systematic literature reviews, 19/100; level II, 8/100; level III, 14/100; level IV, 51/100; level V, 3/100 including 2 technical reviews and 1 case-report; there was 1 cadaver study, 1 lecture, and 1 animal study. Table 1 and Fig. 1 show the mean citation numbers according to level of evidence.

Of the 100 studies, 22 were sponsored by scientific societies, including 10 by the Société française de chirurgie orthopédique et traumatologique (SoFCOT), 6 by the Société francophone d'arthroscopie (SFA), 2 by the Société française de chirurgie de la hanche et du genou (SFHG; including 1 sponsored jointly by the Groupe d'étude en traumatologie [GETRAUM]); 2 by the Association française de chirurgie du pied (AFCP), and 2 by the Société d'orthopédie de l'ouest (SOO).

Table 2 reports the fields of the studies reported by the 100 most-cited articles. This classification inevitably involves loss of information, since a study may be relevant to more than one field (e.g., both traumatology and paediatric surgery). When this was the case, the articles were classified based on surgeon field of specialisation or on anatomical location rather than in the more general category.

Fig. 2 reports the results of the linear regression analysis of Scopus or Google Scholar citations according to article classification. The derivative of the curve differed according to the source. As the number of citations increased, the difference between Scopus and Google Scholar increased also.

## 4. Discussion

France's long history of active research in orthopaedic and trauma surgery has produced many innovations, whose visibility, however, was blurred by the language barrier. Over the last decade, the OTSR has circumvented this barrier to a large extent.

The most-cited article reports a retrospective study by Gallinet et al. [22] on proximal humerus injuries. Trauma surgery is a major focus of current research.

Most of the 100 most-cited articles were published several years ago, and the likelihood of being among the 100 most-cited articles increased with time since publication. It takes time for an article to be referred to in subsequent articles, and over time, the total number of citations increases. The number of citations per year since publication therefore provides useful information. For instance, the 2016 article by Boileau [23], which is in 69th position for overall

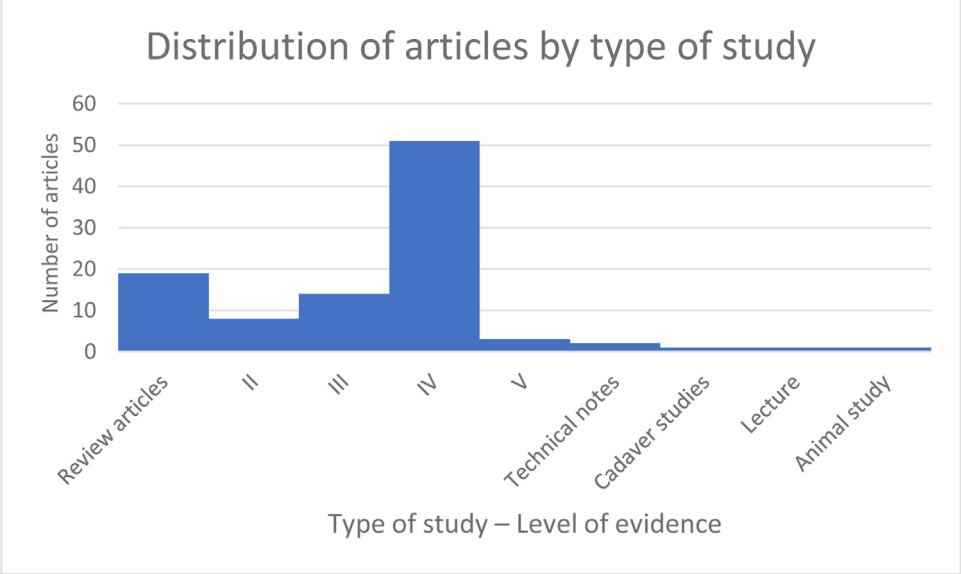


**Fig. 1.** Number of citations by level of evidence and type of article.

**Table 2**
100 most-cited OTSR articles: mean number of citations by field of study.

| Field of study | Number of articles | Mean number of citations | SD | Minimum | Maximum | *p*-value |
|---|---|---|---|---|---|---|
| Basic science | 1 | 44.00 | – | 44 | 44 | – |
| General information | 4 | 47.25 | 11.38 | 37 | 59 | – |
| Hip-pelvis | 29 | 56.41 | 27.11 | 31 | 148 | 0.20 |
| Knee | 25 | 48.44 | 20.41 | 31 | 126 | 0.83 |
| Foot-ankle | 6 | 46.17 | 15.00 | 31 | 71 | 0.73 |
| Shoulder-elbow | 18 | 49.06 | 31.42 | 30 | 169 | 0.93 |
| Trauma | 11 | 47.82 | 23.52 | 30 | 107 | 0.82 |
| Paediatrics | 2 | 30.50 | 0.71 | 30 | 31 | – |
| Tumours | 1 | 34.00 | – | 34 | 34 | – |
| Spine | 2 | 33.00 | 1.41 | 32 | 34 | – |
| Hand | 1 | 32.00 | – | 32 | 32 | – |

OTSR: *Orthopaedics & Traumatology: Surgery & Research*.

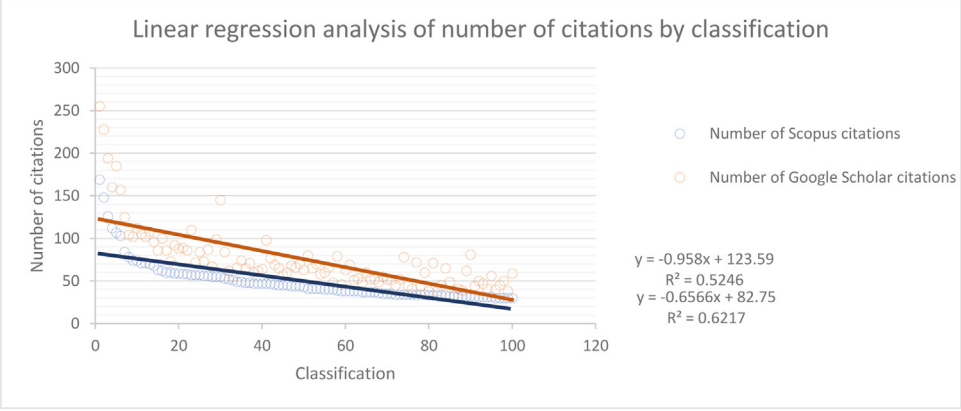


**Fig. 2.** Linear regression analysis of the number of citations according to classification, with Scopus or Google Scholar as the source.

citations, is in fourth position for citations per year. Similarly, the 2017 article by Upex et al. [24] is second for citations per year but is not among the 100 most-cited articles. Thus, the classification will necessarily change over time.

Our study has several limitations. First, although a well-defined method was used to identify the articles, the number of citations retrieved is known to vary considerably according to the identification method used. Major differences were noted between Scopus versus Google Scholar as the source of articles. Scopus retrieves only original articles and can underestimate the number of citations. Furthermore, some articles may be cited as examples of failed or obsolete paradigms. The likelihood of this situation occurring increases with the number of citations. Second, many factors influence the total number of citations. Citations in textbooks, conferences, and other online-only publications were not assessed in this study. Third, as stated above, using the total number of citations as a measure of impact generates a bias in favour of older articles, which have had more time to generate citations. To limit this source of bias, the number of citations per year was determined (Appendix 2). Fourth, this study used a cross-sectional design with a search on a single day. Another search at a later date might have produced a different classification of the articles. An analysis

over time, although challenging to perform, would have provided useful information for understanding the factors that influence citation of an article. Moreover, we did not consider citations by OTSR. Self-citation, despite having a controversial influence, can be encouraged by journals to artificially increase the impact factor [25,26]. Fifth, the number of references supplied by each article was not examined but may correlate with the number of citations [27].

The citation numbers found in this study were lower than those reported for the worldwide orthopaedic literature. For instance, for articles on spinal diseases, at least 343 citations were needed to be among the 100 most-cited worldwide [28]. This lower citation number is directly ascribable to the only 10-year history of OTSR. The results of this study confirm the need for continuously improving the quality of French research. Furthermore, as shown in Table 2, the level of evidence supplied by an article seems to have little influence on the number of citations. Nevertheless, the levels of evidence of the 100 most-cited articles were not compared to those of all OTSR articles. Earlier studies have identified the impact factor of the journal as the most powerful predictor of citations and shown that the majority of most-cited articles were published in high impact factor journals [29–31]. The rise in the OTSR impact factor over time augurs a future increase in citation rates.

## 5. Conclusion

To our knowledge, this is the first long-term study of OTSR article citations. The 100 most-cited articles deserve to be viewed as influential based on both their total and their annual citation numbers. The number of citations seems poised to rise in the future, further increasing the influence of OTSR on worldwide orthopaedic research.

## Disclosure of interest

The authors declare that they have no competing interest in relation with the article. Ties unrelated to this study include consultancy work by SB for Zimmer-Biomet and by MO for Arthrex, Stryker, and Newclip Technics.

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None.

## Contributions of each author

RE contributed to conceive, perform, and supervise the study and contributed to write the article.

GV contributed to conceive and perform the study and contributed to write the article.

MO and NR contributed to write the article.

SD and SB contributed to conceive and supervise the study and contributed to revise the article for important intellectual content.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.otsr.2019.01.016.

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