



Original article

Publication output of French orthopedic and trauma surgeons: Quantitative and qualitative bibliometric analysis of their scientific production in orthopedics and other medical fields



Marc Saab^{a,b,*}, Julien Dartus^{a,b}, Roger Erivan^c, Nicolas Reina^d, Matthieu Ollivier^e, Patrick Devos^f

^a Université de Lille Nord de France, 59000 Lille, France

^b CHU Lille, Service d'Orthopédie, Hôpital Roger-Salengro, 59000 Lille, France

^c Université Clermont Auvergne, CHU Clermont-Ferrand, CNRS, SIGMA Clermont, ICCF, 63000 Clermont-Ferrand, France

^d Département de Chirurgie Orthopédique, Hôpital Pierre-Paul-Riquet, CHU de Toulouse, place du Dr Baylac TSA 40 031, 31059 Toulouse, France

^e Institut du Mouvement et de l'Appareil Locomoteur, Département d'Orthopédie Traumatologie, Hôpital Ste. Marguerite, 13000 Marseille, France

^f Université de Lille, CHU Lille, EA 2694 - Santé publique : épidémiologie et qualité des soins, 59000 Lille, France

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ABSTRACT

Introduction: Bibliometric analysis is being used more and more in orthopedics and traumatology. However, the quantity and quality of publications authored by French orthopedic and trauma surgeons outside their discipline have never been analyzed, nor has the change in the quality of orthopedics publications. This led us to carry out a bibliometric analysis to answer the following questions: 1) How has the quantity of scientific production by French orthopedists changed over the past 10 years? 2) How has the quality of the overall scientific production by French orthopedists changed over the past 10 years?

Hypothesis: From 2008 to 2017, the production of French orthopedists has increased in quantity and quality in orthopedics and other medical fields.

Material and methods: The analysis was performed by cross-referencing the list of SOFCOT (French Society for Orthopaedic Surgery and Traumatology) members with the French SIGAPS database and the InCites platform. Out of 3979 SOFCOT members, 972 (24%) had authored publications during this period and were included in the analysis. Several indicators were analyzed: number of publications; SIGAPS score (production quality) for the various Web of Science (WoS) categories; number and percentage of publications in the top 1% and top 10% (most highly cited articles worldwide).

Results: The “Orthopedics” discipline was still the most prevalent with 68% of all publications identified. The “Surgery” discipline was stable, and the share of publications had increased in five other disciplines: Sports Sciences, Clinical Neurology, Emergency Medicine, Engineering–Biomedical and Material Science–Biomaterials. Of the 727 journals indexed in PubMed in which at least one author is a French orthopedic or trauma surgeon, 79 journals (11%) had at least 10 articles authored by a French orthopedist, making up 4680/6056 published articles (77%) during the study period. The highest SIGAPS score was in the “Orthopedics” discipline followed by “Surgery”, and then by “Sport Sciences” with a large number of publications in the SIGAPS B category. Publications in “Orthopedics” category A and B journals increased 14% during this period. When all disciplines are pooled, the share of publications in SIGAPS A, B and C categories increased by 10% from 2008 to 2017. The largest increase in publications for categories A and B and the top 1% and 10% was in “Sports Sciences”.

Discussion: Over the past 10 years, French orthopedists have continued to increase their scientific production in the orthopedics field and in related fields such as Sport Sciences, Clinical Neurology and Biomedical Engineering. The quality of the scientific production of French orthopedists in their discipline and outside of it has greatly improved, as evidenced by the shift toward SIGAPS A and B journals.

Level of evidence: IV, retrospective study without control group.

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* Corresponding author at: Service d'Orthopédie, Hôpital Roger-Salengro, Centre Hospitalier et Universitaire de Lille, place de Verdun Lille, 59037, France.
E-mail address: marc.saab@outlook.com (M. Saab).

1. Introduction

There is a growing interest in bibliometric analysis for orthopedics and traumatology; most studies show that more articles are being published in these disciplines [1–7]. These analyses are performed to determine the quality and quantity of a certain country's or region's scientific productivity. Several countries have used this approach to improve their standing in the scientific community, especially China [1–12]. But most studies are confined to analyzing the orthopedics field and have not analyzed the contribution of orthopedic surgeons beyond this field (cancer, infection, biomechanics, biostatistics, etc.). Another popular strategy is to determine which articles have been cited the most within a journal [13–15] or in the orthopedics subspecialty [4,7,16–23]. This type of analysis has two goals: determine the “identity card” of the most highly cited articles in their field and serve as a reference for journal readers who want to publish in it. But few studies have been done to look at how the publication habits of orthopedists outside their specialty have changed. Jiang et al. [24] compiled a list of the 100 most cited articles in the field of orthopedic infections. The publications in the journal *The Knee* were analyzed between 1996 and 2016 by Sheridan et al. [25], whereas Erivan et al. studied the features of the 100 most cited publications in *Orthopaedics & Traumatology: Surgery & Research* (OTSR) from 2009 to 2019 [13].

In France, the scientific production of an author, department or hospital is measured with the bibliometric software tool SIGAPS developed by the Lille University Hospital in 2002. This software can analyze the global scientific production (quantity and quality) for a given entity by querying the PubMed database.

But up to now, the publications of French orthopedic and trauma surgeons in orthopedics and outside this discipline have not been analyzed specifically. Also, there is no information on how the quality of their publications has changed over time, both in the orthopedics field and outside of it.

Recently, Dartus et al. evaluated how the number of orthopedics publications in France has evolved relative to that worldwide [26]. The qualitative analysis focused on orthopedics but used only one indicator (articles in top 1% and top 10%). However, no analysis of articles published outside the orthopedics field was done. We felt that an exhaustive analysis of the change in the quality of publications in the orthopedics and traumatology fields and outside of it would better capture the impact of publications by French orthopedic and trauma surgeons. This led us to carry out a bibliometric analysis to answer the following questions:

- How has the publication output of French orthopedists in orthopedics and beyond it changed over the past 10 years?
- How has the quality of the overall scientific production by French orthopedists changed over the past 10 years?

We hypothesized that, from 2008 to 2017, the quantity and quality of the scientific production of French orthopedists has increased in orthopedics and other medical fields.

2. Materials and methods

2.1. Materials

Our analysis was done using the SIGAPS database after its October 2018 update. This database holds publications from 550 affiliated healthcare facilities in France (public and private hospitals, cancer centers, nonprofit institutions) from 2008 to 2017. Data extraction was performed after approval was granted by the clinical research and innovation office (DGOS/PF4).

2.2. Methods

2.2.1. Membership in the SOFCOT entity

To produce a report for an entity (department, unit, French National Board of Universities [CNU]), we needed to assign members to this entity. Thus the first step was to identify, among the 130,000 persons who had a SIGAPS profile, which ones were members of the SOFCOT. Three criteria were used to identify SOFCOT authors in SIGAPS:

- persons associated with subsection 50-02 (CNU section 50, subsection 02: orthopedics/traumatology);
- persons publishing in journals in the Web of Sciences (WoS) “Orthopedics” category;
- persons who link their publications to specific orthopedics/traumatology MeSH Terms.

We then cross-referenced this list with the list of SOFCOT members. Thus among the 3979 members identified by the SOFCOT, we validated a list of 1102 SIGAPS identifiers corresponding to 972 unique individuals who had publications between 2008 and 2017. They were integrated into our analysis (one person who practiced simultaneously or consecutively at multiple facilities had several identifiers in the national database). To make sure the analysis of all SOFCOT publications was exhaustive, all of an author's identifiers had to be taken into account.

2.2.2. SIGAPS data

The use of the SIGAPS has been described in detail previously [27]. To summarize, SIGAPS queries and compiles all the publications indexed in the international PubMed database, which contains the MEDLINE® database and references nearly 5300 medical journals. Any publication that is not found in PubMed will not appear in SIGAPS.

To obtain a journal's impact factor (IF), SIGAPS also queries the Journal Citation Report (JCR) database which contains the IF of journals indexed in the Web of Sciences Core Collection (Clarivate Analytics, Philadelphia, Pennsylvania, USA). The PubMed and Web of Sciences databases are independent: a journal can be indexed in PubMed but not have an IF, and conversely, a journal can have an IF without being indexed in PubMed. In the Web of Sciences, the journals are grouped into 254 subject categories; among them is the “Orthopedics” field, which is separate from the “Surgery” field.

SIGAPS classifies the journals into categories A, B, C, D, E, NC (non-classified) based on the IF of journals within the same discipline and by calculating the IF percentiles within each Web of Sciences category. This is a composite indicator that takes into account both the category of the journal and the position of the authors [27].

A corresponds to the 10% of journals having the highest IF within a discipline, B to the next 15%, C to the next 25% (between quartile 3 and median), D to the journals between quartile 1 and the median, and E to the journals with an IF below quartile 1. NC corresponds to journals indexed by PubMed that do not have an IF.

A qualitative analysis of the SOFCOT entity was carried out using these databases and the distribution into SIGAPS categories.

2.2.3. Analysis of impact

Using the Top 1% and Top 10% analysis method described by Dartus et al. [26], we looked at the number and percentage of publications in the Top 1% and Top 10% authored by a French orthopedist (SOFCOT entity).

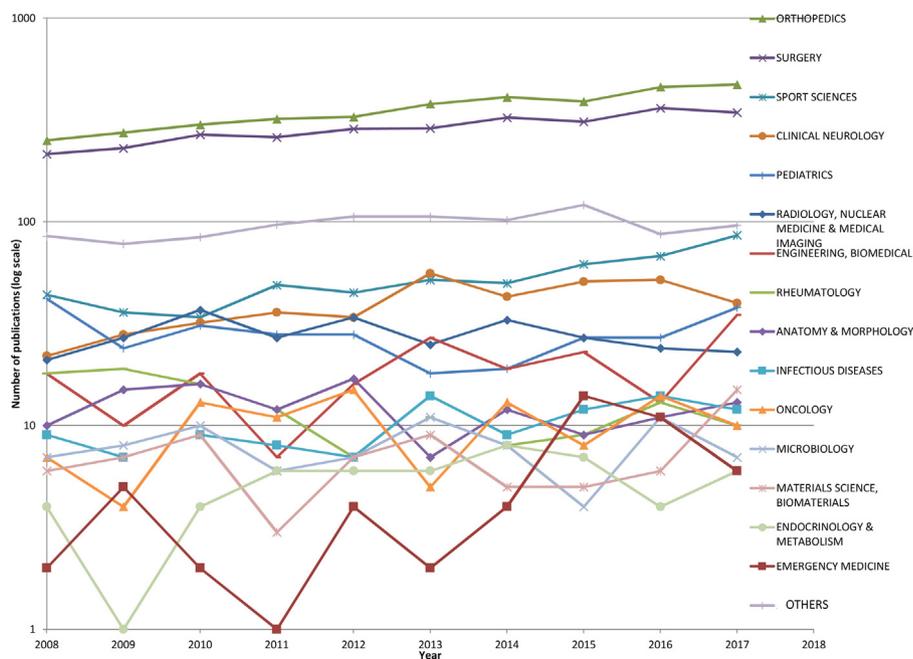


Fig. 1. Change in the number of publications by discipline with 1% or more authored by French orthopedists between 2008 and 2017 (Others—less than 1%, 94 disciplines).

2.3. Statistical methods

This was a descriptive study in which the counts, share, and percent change were determined. No statistical comparisons were performed.

3. Results

3.1. Change in scientific production of French orthopedists outside orthopedics between 2008 and 2017

3.1.1. Change among Web of Science categories

As expected, the “Orthopedics” subject category was the most popular, with more than two-thirds of the publications and a 4.9% increase over the period. The next most popular was “Surgery” with a stable share of 28% during the period of interest (Fig. 1). Among the categories in which the total share of the contributions by French orthopedists from 2008 to 2017 was more than 1%, five had a slight increase in their share of publications: Sports Sciences (+42 publications, +1.31%). Clinical Neurology (+18 publications, +0.41%) Emergency Medicine (+4 publications, +0.26%) (Fig. 1). This increase was also found in the Engineering–Biomedical category (2.37% to 2.88%) and the Material Science–Biomaterials category (0.79% to 1.23%). The share of the other 94 categories in which less than 1% of the articles were published decreased over the study period (–3.28%) (Fig. 1). The data for all the categories are provided in Appendix 1.

3.1.2. Change in SIGAPS categories of journals indexed by PubMed

Between 2008 and 2017, 6056 publications in 727 PubMed-indexed journals were authored by a French orthopedist. Seventy-nine journals (11%) had at least 10 publications featuring a French author (electronic Appendix 2). These 79 journals contained 4680 of the 6056 publications (77%). Several journals were aimed at a different domain or were associated with the “Orthopedics” domain. Beyond orthopedics, the second most common subject category was “Radiology, Nuclear Medicine & Medical Imaging” (5 journals, 193/6056 publications or 3.2%). This was followed by “Engineering–Biomedical”, “Computer Science”, “Material Science,

Biomaterials” (5 journals, 129/6056 publications or 2.1%). Several other subject categories were also targeted, particularly Pediatrics, Microbiology, Infectious Diseases, Rheumatology (11 journals, 290/6056 publications or 4.8%). Other disciplines were represented occasionally: oncology, general medicine, pharmacology, etc. The mean impact factor of these 79 journals was 2.53. Eleven were in SIGAPS category A (14%), 16 in category B (20%), 15 in category C (19%), 13 in categories D and E (16%) and 11 NC (14%).

Lastly, there were 648 journals (727 minus 79) with less than 10 publications authored by a French orthopedist. There were 1376 publications in these journals (23%), or an average of 2 per journal. The IF of these 648 journals was 3.71. More than half were in SIGAPS categories A to C (348 journals, 54%).

3.2. Change in quality of total scientific production of French orthopedists

3.2.1. SIGAPS scores of French orthopedists from 2008 to 2017

One or more French orthopedists were featured on the author list of at least one publication in 109 different disciplines. Among them, the highest SIGAPS score was found in “Orthopedics” as this field had the largest number of publications (3765); the majority were published in the SIGAPS D category. This was followed by the “Surgery” field, with 3026 publications, mainly in the D category. The third was “Sport Sciences” with 477 publications, mainly in category B. Lastly, “Clinical Neurology” had 417 publications, mainly in category C. Another 89 disciplines had fewer than 50 publications authored by a French orthopedist; the cumulative SIGAPS score was not higher than that of the “Sport Sciences” discipline and the publications tended to be mostly in category C. The full set of data on disciplines is given in Appendix 3.

3.3. Change in the SIGAPS scores of French orthopedists from 2008 to 2017

The SIGAPS analysis found 74 disciplines with publications by French orthopedists in category A and B journals. The share of publications in SIGAPS A and B categories increased by 14%, indicating a higher quality of publications in Orthopedics. The share in the C

Table 1
Change in the quality of publications by French orthopedists in the Orthopaedics discipline based on SIGAPS categories between 2008 and 2017.

Year	A	B	C	D	E	NC	Total
2008	7 (2.6%)	16 (6.1%)	79 (30.2%)	13 (5%)	138 (52.7%)	9 (3.4%)	262
2009	15 (5.2%)	18 (6.2%)	80 (27.8%)	29 (10.1%)	139 (48.3%)	7 (2.4%)	288
2010	11 (3.5%)	29 (9.3%)	70 (22.4%)	28 (8.9%)	169 (54%)	6 (1.9%)	313
2011	19 (5.2%)	64 (17.5%)	40 (11%)	185 (50.7%)	51 (14%)	6 (1.6%)	365
2012	18 (5.4%)	68 (20.3%)	41 (12.2%)	154 (46%)	49 (14.6%)	5 (1.5%)	335
2013	10 (2.5%)	56 (13.9%)	103 (25.5%)	166 (41%)	51 (12.6%)	18 (4.5%)	404
2014	15 (3.5%)	41 (9.5%)	112 (25.9%)	183 (42.2%)	65 (15%)	17 (3.9%)	433
2015	11 (2.7%)	109 (26.6%)	60 (14.6%)	169 (41.2%)	38 (9.3%)	23 (5.6%)	410
2016	26 (5.6%)	113 (24.1%)	67 (14.3%)	164 (35%)	83 (17.8%)	15 (3.2%)	468
2017	35 (7.2%)	78 (16%)	127 (26.1%)	213 (43.7%)	19 (3.9%)	15 (3.1%)	487
	167	592	779	1304	802	121	3765

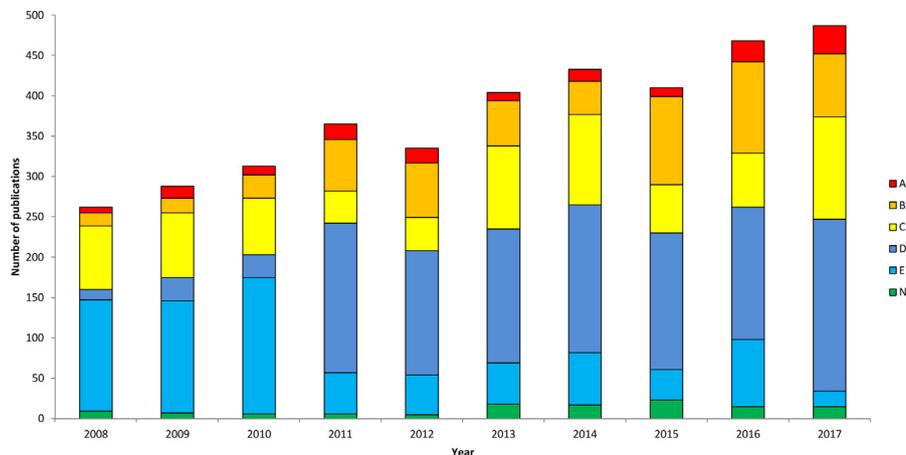


Fig. 2. Change in the quality of publications by French orthopedists in the Orthopaedics discipline based on SIGAPS categories between 2008 and 2017.

and NC categories was stable with about 30% in the C category and 3% in the NC category. There was a large decrease in the number of category E publications starting in 2011 (– 48.8%) associated with a large increase of category D publications in the same years (+ 38.8%) (Table 1, Fig. 2). Overall, in 2008, 39% of the publications were in categories SIGAPS A, B and C; this share increased to 49% in 2017 with a parallel decrease in categories D and/or E and/or NC from 61% to 51% (Fig. 2).

We also found that the quality of publications in non-orthopaedics disciplines had changed. Thus a large share of publications went to A and B journals in Surgery (+ 4.8%), Sport Sciences (largest increase, + 10.7%) and Clinical Neurology (from 0 to 3%). While there were no category A and B publications in the Engineering–Biomedical and Material Science–Biomaterials fields in 2008, these made up 3.3% and 3.0% of the publications, respectively, in 2017 (Table 2). Category A and B publications in all the other fields were stable or decreased, particularly Rheumatology, Anesthesiology, Microbiology, Radiology. Lastly, most fields had at least 1% of their publications in A and/or B journals with at least one French orthopedist among the authors. These fields also had a decreasing share in the study period (– 10.6%). The entire dataset with all fields is given in Appendix 4.

3.4. Change in Top 1% and Top 10% of all publication by French orthopedists between 2008–2012 and 2013–2017

During the periods 2008–2012 and 2013–2017, there was at least one publication by a French orthopedist that was in the Top 1% or Top 10% in 110 fields. All fields combined, there were 19 more publications (+0.5%) in the Top 1% between these two periods. The share of publications in the Top 10% remained stable at 9%. The number of publications in Orthopaedics and Surgery increased in

the Top 1% but decreased in the Top 10% between the two periods. The highest share of publications in the Top 1% or Top 10% were in Sport Sciences. In this discipline, there were 10 more publications in the Top 1% (+ 3%) and + 31 more publications (+ 4%) in the Top 10% from one period to the other (Fig. 3). French orthopedists also published in other disciplines that had a noticeable share of articles in the Top 1% and Top 10%, particularly in Clinical Neurology, Rheumatology and Oncology.

The majority of disciplines had less than 100 publications authored by a French orthopedist. There was a total of 1216 publications, or an average of 12 per discipline. For these disciplines, the Top 1% and Top 10% decreased between the two periods, but the share of publications in the Top 1% and Top 10% varied depending on the period due to the relatively small number of publications. Consequently, some disciplines with a lower number of publications had a relative high Top 1% and Top 10%. All of the data on this topic are given in Appendix 5.

4. Discussion

We hypothesized that between 2008 and 2017, the production of French orthopedist authors had increased in disciplines outside of orthopaedics, while the quality of their scientific production overall, all disciplines combined, had also increased. This study's analysis confirmed our hypothesis.

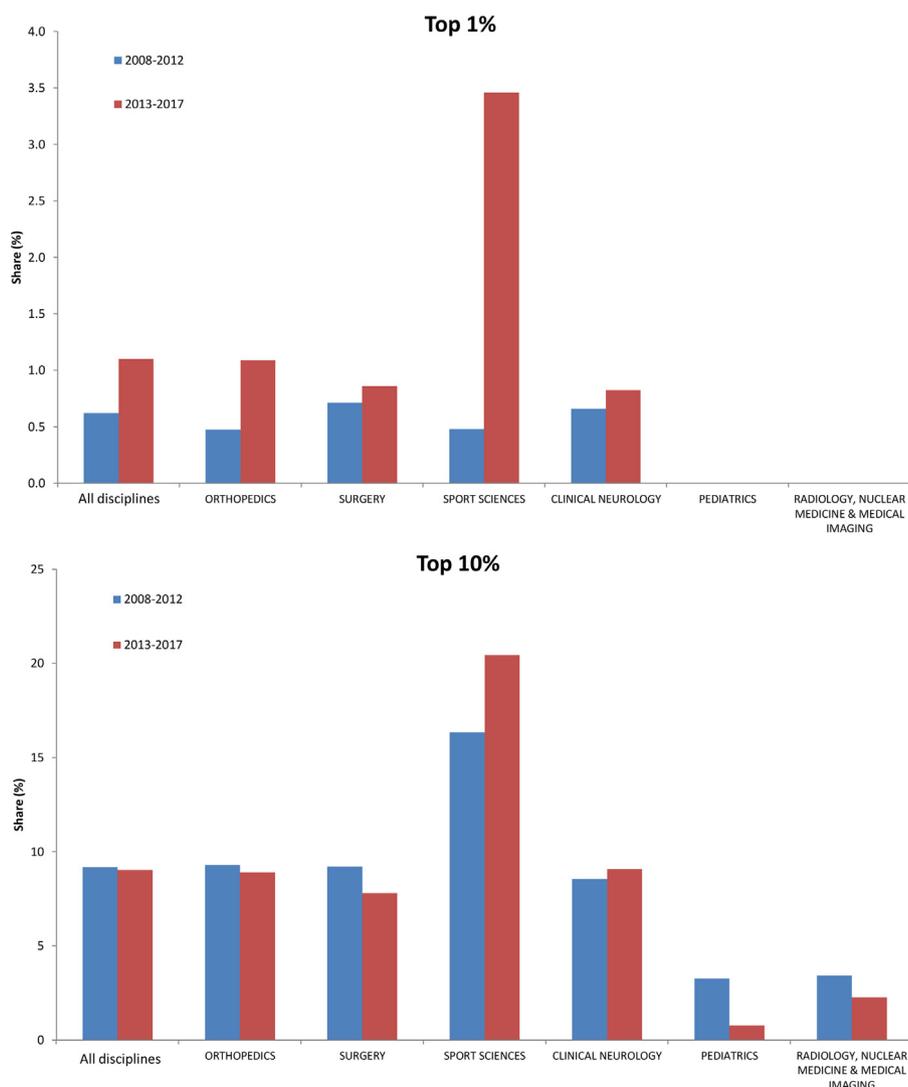
4.1. How has the publication output of French orthopedists in orthopaedics and beyond it changed over the past 10 years?

In the past 10 years, French orthopedists continued to increase the number of publications in orthopaedics and also in Web of Sciences categories other than Orthopaedics. These disciplines are

Table 2

Change in the quality of publications by French orthopedists in all disciplines based on SIGAPS categories between 2008 and 2017.

Code	Discipline	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total	% AB
TC	Orthopedics	23	33	40	83	86	66	56	120	139	113	759	20.16
YA	Surgery	19	26	30	68	60	63	41	66	84	89	546	18.04
XW	Sport sciences	5	5	13	36	32	43	24	46	47	58	309	64.78
WH	Rheumatology	11	9	11	6	1	4	2	5	6	4	59	49.17
QU	Microbiology	3	7	7	5	5	8	6	1	6	5	53	67.95
RO	Multidisciplinary sciences	2	1	4	1	7	8	5	3	6	9	46	91.20
VY	Radiology, Nuclear Medicine & Medical Imaging	3	4	3	5	8	7	5	3	3	4	45	15.36
DM	Oncology	3	1	3	2	5	4	5	3	6	6	38	40
NN	Infectious diseases	1	4	5	6	3	3	3	3	3	4	35	35
IG	Engineering, biomedical	0	3	3	1	2	8	3	1	1	12	34	16.83
QE	Materials science, biomaterials	0	3	3	2	2	8	2	1	1	11	33	452
RT	Clinical neurology	0	1	0	2	3	4	3	4	3	11	31	7.43
BA	Anesthesiology	4	4	3	1	3	2	4	1	0	3	25	49
TU	Pharmacology & pharmacy	0	1	4	0	0	2	6	1	4	5	23	53.49
DR	Cell biology	1	4	1	0	2	2	2	1	3	2	18	40
DS	Critical care medicine	2	6	2	1	0	2	1	0	1	3	18	36
IA	Endocrinology & metabolism	2	0	3	5	1	2	0	1	1	3	18	36
NI	Immunology	0	4	3	3	1	1	1	0	0	2	15	42
WC	Rehabilitation	0	0	0	1	1	1	4	3	2	2	14	35.90
DB	Biotechnology & applied microbiology	1	2	1	0	1	2	3	2	0	1	13	39
FF	Emergency medicine	2	6	2	1	0	2	0	0	0	0	13	22
KM	Genetics & heredity	0	1	2	2	2	4	1	0	1	0	13	33
	Other (52 disciplines) ^a	16	19	11	25	24	22	20	21	12	21	191	35.0
	Total A/B category per year	98	144	154	256	249	268	197	286	329	368	2349	22.9

^a All the other 52 disciplines.**Fig. 3.** Change in quality of publications by French orthopedists in the Top 1% and Top 10% of publications in the top 6 disciplines.

however very closely related as they involve “Sport Sciences” which captures sports medicine journals and “Clinical Neurology” which encompasses spine surgery journals. Of note, French orthopedic surgeons were also publishing more in disciplines such as “Engineering–Biomedical”, “Computer Science”, and “Material Science–Biomaterials”. Except for these disciplines, the share of all the other disciplines in which French orthopedists published was already low in 2008 and was even lower in 2017. Among them are fields related to orthopedics such as anesthesia, rehabilitation and physical medicine. This trend can in part be explained by the requirement for authors involved in the publication and who aspire to an academic career in orthopedics. In fact, the disciplines with an increasing share are recognized as a closely related discipline by the French National Board of Universities when evaluating scientific production of an orthopedic surgeon.

The publication output in non-orthopedic disciplines has rarely been evaluated by authors who perform country-based bibliometric analyses. According to Shon et al. [10], the global scientific contribution of South Korea was 2161 articles (5.6%) in the 15 journals with the highest impact factor in 2017 and over the same period as our study. Like French orthopedists, the share of Korean publications in “Sports Medicine” is considerable. It was in 2nd place for publications in American Journal of Sports Medicine with 249 publications while French orthopedists had 40 publications. In Australia, the analysis encompassed all orthopedics and related disciplines; the publications between 2010 and 2015 in the 15 journals with the highest IF targeted an appreciable share of sports medicine journals (AMJSM 26/478 [5%] publications, KSSTA 31/478 [6%]) and spine surgery journals (Spine J, Spine, Eur J Spine make up 107/478 [22%] publications) [11]. This progression was reported by Cheng et al. [1]: Chinese orthopedists have increased the number of publications in these same fields. Of note, the share of Chinese publications in spine surgery was especially large, as highlighted by Sun et al. [3] and Jia et al. [4]. Comparatively, France was in 10th place in 2013 with 355 publications [7].

Of the 79 journals in which at least 10 publications were authored by a French orthopedist, 28 journals dealt with related disciplines. Corollary of the increase in publications in Web of Sciences subject categories, we saw a slight increase in the share in sports medicine, spine surgery, engineering and also biomaterials journals. The mean IF of the 79 journals in which at least 10 publications were authored by a French orthopedist was 2.53, while the IF of the 648 journals with less than 10 publications featuring at least one French orthopedist as author was 3.71. The higher IF in this group can be explained by the large number of journals in this group, which included medical journals with very high IF (NEJM, The Lancet, JAMA among others).

4.2. How has the quality of the overall scientific production by French orthopedists changed over the past 10 years?

An original element of our study is that we used SIGAPS analysis to separate the journals by their IF within their discipline. This helps to get around the limitations of a qualitative analysis based solely on IF, which may not properly reflect a journal's clinical impact given how the IF is calculated [28,29].

Decidedly, the quality of the scientific production of French orthopedists has greatly improved over the past 10 years. The disciplines with the highest SIGAPS scores in 2017 were Orthopedics, Surgery, Sports Sciences and Clinical Neurology. The latter are highly related to orthopedics. The quality of publications in these four disciplines increased, as evidenced by the larger share of articles in SIGAPS category A and B journals. Here again, disciplines such as Biomedical Engineering and Biomaterials have emerged. Certain disciplines such as Rheumatology, Anesthesiology, Microbiology, Radiology had stable or slight lower overall quality of

publications by French orthopedists. Overall in 2017, nearly 50% of publications featuring at least one French orthopedist as an author, all disciplines combined, were in SIGAPS categories A, B or C (50th percentile) versus less than 40% in 2008.

If we specifically look at the Orthopedics discipline, the distribution of articles within the SIGAPS categories changed drastically over the past 10 years. Thus in 2017, the most common SIGAPS was D, while in 2010 it was E. This very likely due to *Orthopaedics & Traumatology: Surgery & Research* (OTSR) being established in 2009 as it is now the primary journal for French orthopedics practice. This journal is the electronic, English version of *Revue de Chirurgie Orthopédique et Traumatologique*, which is no longer indexed in Medline and was always category E. This drastic change was due to the publication in English of articles written by French orthopedists, which improved their visibility to the scientific community. This shift to English was also done recently by the journal *Chirurgie de la Main* (category E) which became *Hand Surgery & Rehabilitation* (category D). This English-language domination was highlighted by Holzer et al. [20] in their analysis of the 50 most cited articles in orthopedics for hip and knee arthroplasty. Chinese authors attribute their delayed visibility in orthopedics in part to this language effect [30].

As for the Top 1% and Top 10% articles authored by a French orthopedist, the global share of publications has mainly increased in Sports Sciences, with all the other disciplines being stable between the periods 2008–2012 and 2013–2017. In the literature, only a few countries have evaluated their share of publications in high IF journals, generally the first 15 journals in the Web of Sciences “Orthopedics” listing for a given year [1,5,8–12]. One way to analyze the quality of publications is to analyze the 25 to 100 most cited articles in the orthopedics subspecialty. Practically all subspecialties have adopted this approach and French orthopedists seem to always be represented. According to Lefavre et al. [31], two articles authored by French orthopedists are among the 100 most cited articles in orthopedics. According to Jiang et al. [24], three articles authored by French orthopedists are among the 100 most cited articles in bone and joint infections. But according to Cassar Gheiti et al. [23], there are no articles by French orthopedists among the 25 most cited articles in arthroscopy. Three articles authored by French orthopedists are among the 50 most cited articles in hip and knee arthroplasty [20], 2 in shoulder surgery [18] and 1 in foot and ankle surgery [17].

4.3. Limitations

This study has several limitations:

- SIGAPS queries the PubMed database; thus any publication not found in PubMed will not be found in SIGAPS. Also, when determining a journal's IF, SIGAPS uses the Journal Citation Report based on the Web of Sciences. Since these two databases are independent, some publications authored by French orthopedists may not have been captured in our analysis if they were not in journals indexed by PubMed. Likewise, high IF journals may not have been captured in the qualitative analysis if they were in the Web of Sciences but not indexed in PubMed. The independence of these two database was taken into account in our study since the quantitative analysis was done using the Web of Sciences disciplines along with the journals indexed by PubMed. Likewise, in the qualitative analysis that was done by looking at the changes in SIGAPS categories and the Top 1% and Top 10% analyses, the PubMed identifiers (PMID) were used and transferred to the InCites platform then grouped by Web of Sciences categories;
- another limitation of our study is the use of the IF for determining a journal's quality. This IF is determined each year by taking the

ratio of the number of citations to the number of publications in the prior 2 years. However, the time needed for an article to reach its peak orthopedics visibility may be more than 2 years. Kodumuri et al. [28] suggested using a 5-year period post-publication to determine an article's importance. To try to limit the impact of this bias, we evaluated quality over two 5-year periods during the Top 1% and Top 10% analysis;

- while the SIGAPS software is widely used in France, it does not capture all the hospitals and clinics. Consequently, the quality and quantity of scientific production by some authors may not have been captured in this study if their facility does not use SIGAPS. Nevertheless, SIGAPS is now used by 550 healthcare facilities; it is mainly non-hospital specialists and offices that are not covered. We investigated the contribution of certain “high publishers” in liberal practice whose data is not captured in SIGAPS because their facility does not use it. While it is impossible to counter this limitation, the large number of “publishers” with the French orthopedic ranks who are member of the SOFCOT (972/3979 [24%]) helps to limit the impact of this bias;
- not all French orthopedic surgeons are members of the SOFCOT, thus some authors may not have been included in this study;
- lastly, the rank of the French authors on a publication was not analyzed here; therefore, their true contribution in disciplines other than orthopedics may vary depending on their position on a publication's author list.

5. Conclusion

Over the past 10 years, French orthopedists have both increased their scientific productivity in orthopedics and in several closely related disciplines such as sports medicine, spine surgery and more recently, biomedical engineering and biomaterials. The quality of scientific production in orthopedics and other medical disciplines has improved, such that 50% of publications are in the best SIGAPS categories for orthopedics. The sports sciences discipline has a large share of articles in the Top 1% and Top 10% in 2017. The increased visibility of French orthopedists is in large part attributed to the establishment of Orthopaedics & Traumatology: Surgery & Research.

Disclosure of interest

Marc Saab, Julien Dartus, Patrick Devos and Roger Erivan have no conflict of interest to disclose related or unrelated to this work. Outside this study, Nicolas Reina declares having been reimbursed for personal expenses by BBraun, Stryker and Zimmer. Outside this study, Matthieu Olivier declares being an occasional educational consultant for Zimmer/Biomet, Smith & Nephew.

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Authors' contributions

PD – data extraction and analysis; writing of article.
MS, JD – data analysis; writing of article.
RE, MO and NR – critical review and revision of article.

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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.2019.09.018>.

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