Global and Chinese publications in plastic surgery journals between 2010 and 2020: a bibliometric analysis

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Background: Plastic surgery has evolved rapidly in recent years. We performed a bibliometric analysis of plastic surgery publications from 2010 to 2020 to evaluate global developments in plastic surgery and the Chinese contribution to this field.

Methods: The 2020 Journal Citation Reports (JCR) was used to identify all plastic surgery journals; those that were available on the Web of Science database were retrieved and analyzed according to their number of published articles, citation rates, impact factors (IFs), research funding, and article references. We also determined the most popular journals for research from the 8 top-ranking countries in terms of contributed articles, including China.

Results: From 2010 to 2020, 55,554 articles were published in the 35 selected plastic surgery journals. China, which contributed 9.48% of these articles, was the country with the second-highest number of articles published, a number which has been increasing annually. The average IF of Chinese articles was 1.74, with an average citation count of 6.68. These figures were significantly lower than those for articles from developed countries. China contributed 1,641 articles to the 10 highest impact plastic surgery journals. The *Journal of Craniofacial Surgery* was the most popular in terms of contributions by China. China had the highest rate of articles supported by funding (45.30%). The top 12 research-topic clusters were obtained by analyzing the references in the articles. Emerging research-topic trends worldwide and in China included fat grafting and blindness after filler injection.

Conclusions: From 2010 to 2020, research into plastic surgery increased continuously, both worldwide and in China. However, the quality of the Chinese articles was lower than that of other top-ranked countries. Researchers who have elected to conduct research might consider emerging trends when designing future studies.

Keywords: Bibliometric analysis; research trends; plastic surgery

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Introduction

Over the past decade, the quality of articles contributed by plastic surgeons to plastic surgery journals has significantly increased (1). There is considerable variation in the distribution of contributing countries to some prestigious plastic surgery journals (2,3). China has invested much in biomedical research and development (R&D), leading to developments in various surgical specialties in the past years (4-7). Studies have revealed that during the 2000's, articles from China increased markedly in the field of plastic surgery, yet the publications remained of a lower quality

Table 1 Titles and impact factors of the included plastic surgery journals

Journal	IF
Plast Reconstr Surg	4.209
Aesthet Surg J	3.799
JAMA Facial Plast Su	3.787
Burns Trauma	3.088
Dermatol Surg	2.567
J Plast Reconstr Aes	2.39
J Hand Surg Eur Vol	2.29
J Hand Surg-Am	2.124
Int J Oral Max Surg	2.068
Burns	2.066
Microsurg	1.996
Clin Plast Surg	1.959
J Reconstr Microsurg	1.841
Aesthet Plast Surg	1.798
J Cosmet Dermatol	1.621
J Cranio Maxill Surg	1.766
Oral Maxil Surg Clin	1.554
Facial Plast Surg Cl	1.543
J Burn Care Res	1.533
Ann Plas Surg	1.354
Cleft Palate-Cran J	1.347
Ophthal Plast Recons	1.331
Wounds	1.326
Semin Plast Surg	1.3
J Cosmet Laser Ther	1.266
J Plast Surg Hand Su	1.235
Hand Clin	1.181
J Stomatol Oral Maxillofac Surg	1.152
Facial Plast Surg	1.108
Brit J Oral Max Surg	1.061
Hand Surg Rehabil	0.961
J Craniofac Surg	0.953
Handchir Mikrochir P	0.84
Plast Surg	0.754
Ann Chir Plast Esth	0.752

IF, impact factor.

compared to those from other top-ranking countries (7,8). However, a bibliometric analysis has not been conducted recently to elucidate the progress and current state of plastic surgery research.

This study aimed to systematically analyze the publication quantity, quality, and trends in plastic surgery journals from 2010 to 2020, evaluating both global development and Chinese contributions in the field of plastic surgery.

Methods

Search strategy

The Clarivate Analytics 2020 Journal Citation Reports (JCR) was used to identify the major journals within the field of plastic surgery; we also referred to the journals listed in a study by Asaad *et al.* (9). A total of 35 journals were selected for our bibliometric analysis (*Table 1*). On 26 February, 2021, we searched the Web of Science to access all articles from these journals that had been published between 1 January, 2010 and 31 December, 2020, using the International Standard Serial Number (ISSN) of the printed editions for the search. The country of origin for each article was determined based on the corresponding author's affiliation. All original articles from the 8 countries with the most publications, namely, the United States, China, South Korea, Great Britain, Turkey, Germany, Japan, and Italy, were analyzed. Any publications categorized as letters, editorials, corrections, biographical items, news items, book reviews, early access, retractions, or meeting abstracts were excluded.

To assess the quantity and quality of the journals, we extracted the following variables from the Web of Science: country of provenance, number of articles published in the major plastic surgery journals, journal impact factors (IFs), citation counts, whether the article was published in a high-impact journal, the most popular journals in each country studied, and the number of articles supported by funding. We defined "high-impact journals" as the 10 journals with the highest IF according to the 2020 JCR, and the "most popular journals" as the 10 journals with the highest number of articles published between 2010 and 2020.

Statistical analyses

Statistical analyses were performed using the software SPSS 26.0 (IBM Corp., Armonk, NY, USA). A linear regression

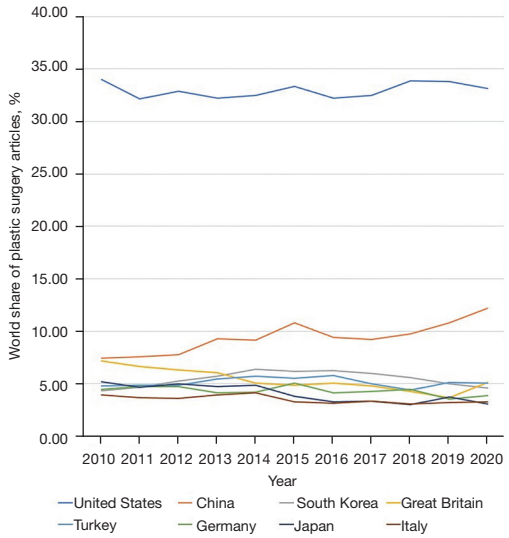

Figure 1 The proportion of articles published in plastic surgery journals from eight countries [2010–2020].

model was used to describe the changes in the number of articles published annually, and Pearson's correlation coefficient (r) was calculated. A Kruskal-Wallis test was used to detect differences among the 8 countries. A pairwise rank-sum test was used to compare the publications in China to those of the other 7 countries. A P value <0.05 was considered statistically significant. CiteSpace V (http://cluster.ischool.drexel.edu/~cchen/citespace/) was employed to analyze the references in the articles and build a co-citation network, using the top 50 keywords and 30 cited articles in a 1-year slice. Pathfinder was applied to prune the merged network. Research-topic clusters in the reference co-citation network were identified according to the citing literature's keywords, and determined using the latent semantic indexing (LSI) and log-likelihood ratio (LLR) algorithms. CiteSpace was also used to analyze the studies that had citation bursts; those with a citation burst in 2019–2020 were regarded as predictive of emerging trends.

Results

The number of articles in the field of plastic surgery

With the predetermined exclusion criteria applied, a total of 55,554 articles were published in the selected 35 plastic surgery journals from 2010 to 2020, inclusive. The original Web of Science records for these articles were exported to Excel (Microsoft, Redmond, WA, USA) for analysis. China contributed 9.48% of these articles, which was less than the United States (32.97%, P=0.003) but greater than South Korea (5.45%, P=0.003), Great Britain (5.27%, P=0.003), Turkey (5.13%, P=0.003), Germany (4.28%, P=0.003), Japan (4.00%, P=0.003), and Italy (3.47%, P=0.003) (*Figure 1*, *Table 2*). The frequency of Chinese publications increased over the 11 years, from 318 to 672 (r=0.939, P<0.001), following the trend of publication frequency from the United States (r=0.928, P<0.001), Turkey (r=0.632, P=0.037), and worldwide (r=0.94, P<0.001). In contrast, the number of articles published by Great Britain and Japan decreased (r=–0.706, P=0.015; r=–0.632, P=0.037, respectively). Our analysis revealed no significant trends in the number of publications from South Korea (r=0.559, P=0.076), Germany (r=0.305, P=0.361), or Italy (r=0.094, P=0.784) (*Figure 2*). As for the proportion of articles from each country, there was an increase in articles from China (r=0.873, P<0.001), and a decrease in articles from Great Britain (r=–0.882, P<0.001), Germany (r=–0.608, P=0.047), Japan (r=–0.891, P<0.001), and Italy (r=–0.736, P=0.010). The proportion of articles from the United States (r=0.221, P=0.513), South Korea (r=0.027, P=0.626), and Turkey (r<0.001, P=0.982) remained relatively stable.

IF and citation reports

The average IFs were calculated based on data from the 2020 JCR (*Table 3*). The average IF for articles from China was 1.74, lower than the average IFs for articles from the United States (2.25, P=0.003) and Japan (1.84, P=0.008), comparable to the those for articles from South Korea (1.69, P=0.056), Great Britain (1.74, P=0.689), and Italy (1.66, P=0.056), and higher than those for articles from Turkey (1.40, P=0.003) and Germany (1.69, P=0.014). The total number of citations for Chinese publications was 35,199 (*Table 4*), which was fewer than the total number of citations for the United States (203,934, P=0.003), but higher than those for the other countries studied. In addition, the average citation count was 6.68 for articles from China, which was markedly lower than the citation counts for articles from the United States (11.13, P=0.003), Great Britain (8.98, P=0.01), Germany (9.75, P=0.003), and Italy (10.36, P=0.003), comparable to those from the other 2 East Asian countries, South Korea (6.85, P=0.05) and Japan (7.85, P=0.859), and higher than those from Turkey (5.02, P=0.003).

Journal analysis

The top 10 plastic surgery journals with the largest number

Table 2 Number and percentage of articles in 35 plastic surgery journals

Year	United States, n (%)	China, n (%)	South Korea, n (%)	Great Britain, n (%)	Turkey, n (%)	Germany, n (%)	Japan, n (%)	Italy, n (%)	Worldwide
2010	1,458 (33.99)	318 (7.41)	185 (4.31)	306 (7.13)	206 (4.80)	192 (4.48)	222 (5.18)	168 (3.92)	4,289
2011	1,389 (32.17)	327 (7.57)	202 (4.68)	287 (6.65)	208 (4.82)	203 (4.70)	202 (4.68)	157 (3.64)	4,318
2012	1,568 (32.91)	371 (7.79)	250 (5.25)	300 (6.30)	230 (4.83)	223 (4.68)	238 (4.99)	171 (3.59)	4,765
2013	1,616 (32.23)	464 (9.25)	286 (5.70)	302 (6.02)	274 (5.46)	205 (4.09)	237 (4.73)	197 (3.93)	5,014
2014	1,666 (32.48)	470 (9.16)	325 (6.34)	260 (5.07)	293 (5.71)	216 (4.21)	249 (4.85)	211 (4.11)	5,129
2015	1,655 (33.31)	536 (10.79)	307 (6.18)	241 (4.85)	273 (5.49)	249 (5.01)	187 (3.76)	162 (3.26)	4,969
2016	1,668 (32.24)	485 (9.38)	322 (6.22)	262 (5.06)	300 (5.80)	214 (4.14)	170 (3.29)	162 (3.13)	5,173
2017	1,678 (32.47)	476 (9.21)	307 (5.94)	248 (4.80)	258 (4.99)	218 (4.22)	172 (3.33)	172 (3.33)	5,168
2018	1,869 (33.84)	537 (9.72)	308 (5.58)	235 (4.25)	241 (4.36)	246 (4.45)	165 (2.99)	170 (3.08)	5,523
2019	1,920 (33.77)	613 (10.78)	284 (4.99)	208 (3.66)	290 (5.10)	201 (3.53)	211 (3.71)	180 (3.17)	5,686
2020	1,828 (33.12)	672 (12.17)	253 (4.58)	281 (5.09)	279 (5.05)	211 (3.82)	169 (3.06)	180 (3.26)	5,520
Total	18,315 (32.97)	5,269 (9.48)	3,029 (5.45)	2,930 (5.27)	2,852 (5.13)	2,378 (4.28)	2,222 (4.00)	1,930 (3.47)	55,554
Median	1,666 (32.48)	476 (9.28)	286 (5.58)	262 (5.11)	273 (5.32)	214 (4.17)	202 (3.94)	171 (3.33)	5,129
[a]P value	0.003		0.003	0.003	0.003	0.003	0.003	0.003	

[a]P value in comparison with China (Pairwise rank-sum tests were used for comparisons after the Kruskal-Wallis test showed statistical differences among the 8 countries).

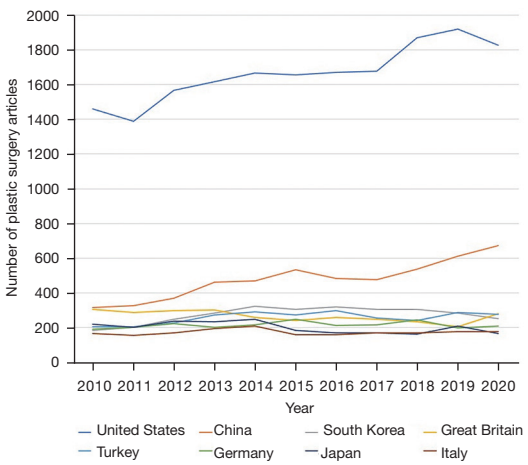

Figure 2 Number of articles published in plastic surgery journals from eight countries [2010–2020].

of published articles are shown in *Table 5*. A total of 21,085 articles were published in these journals from 2010 to 2020, accounting for 37.95% of all articles. The United States published most of these articles (8,500; 40.31%), while China published 1,641 articles in these journals, making it the second-largest contributor. *Table 6* lists the 10 most popular plastic surgery journals for authors from the 8 countries analyzed. The *Journal of Craniofacial Surgery* was the most popular journal in China, South Korea, Turkey, Japan, and Italy, while in the United States, *Plastic and Reconstructive Surgery* was the most popular journal. The 3 most popular journals in China also included the Annals of Plastic Surgery and the *International Journal of Oral and Maxillofacial Surgery*, publishing 547 and 337 articles, respectively, from 2010 to 2020. The British Journal of Oral and Maxillofacial Surgery was the most popular journal in Great Britain, and the Journal of Cranio-maxillofacial Surgery was the most popular in Germany; both journals specialize in craniofacial surgery.

Funding support

The numbers and percentages of articles supported by funding are listed in *Table 7*. China had the highest funding rates from 2010 to 2020, with 45.3% of articles supported by funding. Of these, 1,134 were funded by the National Natural Science Foundation of China (NSFC). South Korea ranked second, with 31.69% of articles supported by funding, followed by the United States (24.07%), Japan

Table 3 The average IF of articles from eight countries [2010–2020]

Year	Average IF							
	United States	China	South Korea	Great Britain	Turkey	Germany	Japan	Italy
2010	2.29	1.96	1.87	1.88	1.49	1.76	1.93	1.63
2011	2.31	1.91	1.73	1.74	1.44	1.71	1.92	1.63
2012	2.19	1.73	1.6	1.91	1.44	1.67	1.83	1.66
2013	2.32	1.72	1.61	1.76	1.44	1.69	1.82	1.73
2014	2.31	1.65	1.67	1.77	1.39	1.7	1.8	1.59
2015	2.24	1.64	1.68	1.79	1.41	1.59	1.92	1.75
2016	2.28	1.76	1.71	1.69	1.38	1.76	1.81	1.64
2017	2.23	1.72	1.62	1.68	1.4	1.66	1.87	1.76
2018	2.17	1.76	1.64	1.7	1.34	1.69	1.93	1.58
2019	2.22	1.73	1.82	1.65	1.37	1.67	1.74	1.65
2020	2.18	1.7	1.71	1.56	1.37	1.69	1.75	1.69
Total	2.25	1.74	1.69	1.74	1.40	1.69	1.84	1.66
Median	2.24	1.73	1.68	1.74	1.4	1.69	1.83	1.65
[a]P value	0.003		0.056	0.689	0.003	0.014	0.008	0.056

[a]P value in comparison with China (Pairwise rank-sum tests were used for comparisons after the Kruskal-Wallis test showed statistical differences among the 8 countries). IF, impact factor.

Table 4 The total number of citations and average citation count of articles from eight countries [2010–2020]

Year	Total number of citations								Average citation count							
	United States	China	South Korea	Great Britain	Turkey	Germany	Japan	Italy	United States	China	South Korea	Great Britain	Turkey	Germany	Japan	Italy
2010	30,722	4,840	2,597	4,956	2,107	3,848	2,780	2,601	21.07	15.22	14.04	16.2	10.23	20.04	12.52	15.48
2011	29,498	4,284	2,617	3,672	1,724	3,416	2,933	2,950	21.24	13.1	12.96	12.79	8.29	16.83	14.52	18.79
2012	29,066	4,180	2,846	4,102	1,875	3,828	2,573	2,600	18.54	11.27	11.38	13.67	8.15	17.17	10.81	15.2
2013	25,402	4,656	2,887	3,059	1,903	2,365	2,241	2,583	15.72	10.03	10.09	10.13	6.95	11.54	9.46	13.11
2014	22,941	4,333	2,952	2,743	1,926	2,326	2,302	2,950	13.77	9.22	9.08	10.55	6.57	10.77	9.24	13.98
2015	20,187	3,899	2,314	2,590	1,515	2,433	1,549	1,883	12.2	7.27	7.54	10.75	5.55	9.77	8.28	11.62
2016	16,504	3,138	1,790	1,970	1,330	1,784	1,287	1,504	9.89	6.47	5.56	7.52	4.43	8.34	7.57	9.28
2017	13,579	2,334	1,278	1,615	785	1,520	758	1,408	8.09	4.9	4.16	6.51	3.04	6.97	4.41	8.19
2018	9,274	2,051	915	997	631	1,087	518	823	4.96	3.82	2.97	4.24	2.62	4.42	3.14	4.84
2019	5,395	1,103	438	420	391	415	438	492	2.81	1.8	1.54	2.02	1.35	2.06	2.08	2.73
2020	1,366	381	119	184	133	169	69	203	0.75	0.57	0.47	0.65	0.48	0.76	0.41	1.13
Total	203,934	35,199	20,753	26,308	14,320	23,191	17,448	19,997	11.13	6.68	6.85	8.98	5.02	9.75	7.85	10.36
Median	20,187	3,899	2,314	2,590	1,515	2,326	1,549	1,883	12.2	7.27	7.54	10.13	5.55	9.77	8.28	11.62
[a]P value	0.003		0.003	0.006	0.003	0.003	0.003	0.003	0.003		0.05	0.01	0.003	0.003	0.859	0.003

[a]P value in comparison with China (Pairwise rank-sum tests were used for comparisons after the Kruskal-Wallis test showed statistical differences among the 8 countries).

Table 5 Articles published in the ten highest-impact journals from eight countries [2010–2020]

Rank	Journal	IF	United states (%)	China (%)	South Korea (%)	Great Britain (%)	Turkey (%)	Germany (%)	Japan (%)	Italy (%)	Total
1	*Plast Reconstr Surg*	4.209	3,351 (64.82)	305 (5.90)	169 (3.27)	94 (1.82)	37 (0.72)	79 (1.53)	122 (2.36)	91 (1.76)	5,170
2	*Aesthet Surg J*	3.799	763 (55.45)	64 (4.65)	31 (2.25)	47 (3.42)	58 (4.22)	13 (0.94)	10 (0.73)	50 (3.63)	1,376
3	*JAMA Facial Plast Su*	3.787	329 (77.59)	12 (2.83)	15 (3.54)	4 (0.94)	7 (1.65)	9 (2.12)	0 (0.00)	4 (0.94)	424
4	*Burns Trauma*	3.088	35 (19.02)	57 (30.98)	2 (1.09)	12 (6.52)	1 (0.54)	2 (1.09)	9 (4.89)	1 (0.54)	184
5	*Dermatol Surg*	2.567	1,105 (54.65)	105 (5.19)	179 (8.85)	23 (1.14)	33 (1.63)	74 (3.66)	35 (1.73)	40 (1.98)	2,022
6	*J Plast Reconstr Aes*	2.39	381 (12.73)	317 (10.59)	194 (6.48)	524 (17.51)	71 (2.37)	125 (4.18)	271 (9.05)	90 (3.01)	2,993
7	*J Hand Surg Eur Vol*	2.29	138 (11.10)	76 (6.11)	66 (5.31)	180 (14.48)	40 (3.22)	48 (3.86)	73 (5.87)	24 (1.93)	1,243
8	*J Hand Surg-Am*	2.124	1,790 (62.83)	95 (3.33)	81 (2.84)	59 (2.07)	25 (0.88)	51 (1.79)	159 (5.58)	17 (0.60)	2,849
9	*Int J Oral Max Surg*	2.068	171 (6.83)	337 (13.47)	77 (3.08)	111 (4.44)	94 (3.76)	115 (4.60)	200 (7.99)	96 (3.84)	2,502
10	*Burns*	2.066	437 (18.82)	273 (11.766)	46 (1.98)	196 (8.44)	57 (2.45)	88 (3.79)	35 (1.51)	16 (0.69)	2,322
Total			8,500 (40.31)	1,641 (7.78)	860 (4.08)	1,250 (5.93)	423 (2.01)	604 (2.86)	914 (4.33)	429 (2.03)	21,085

IF, impact factor.

(24.03%), Germany (15.77%), Great Britain (15.12%), Turkey (8.73%), and Italy (6.17%).

Analysis of references

Clusters of co-cited references in global and Chinese articles were generated. The keywords are listed in *Tables 8*,*9* for a more comprehensive summary of the research topics. The most recent global clusters included Clusters #2, #8, and #10 with an average publication year of 2016. By taking a closer look at the most recent clusters worldwide (Clusters #2, #8, and #9), we could infer that fat grafting and breast implant-associated anaplastic large cell lymphoma were the predominant worldwide focuses of recent research. In China, the most recent clusters were Clusters #5 and #9, indicating novel fat-grafting techniques, hypertrophic scars and keloids, and computer-aided craniomaxillofacial surgery were focuses of study in China more recently.

References in global and Chinese articles with the strongest citation bursts in 2019 and 2020 are shown in *Tables 10*,*11* (10-28). We concluded that the topics of these articles revealed emerging trends from another aspect. Cellular events and techniques of fat grafting, and mortality from gluteal lipo-injection were reported upon (16-19), suggesting that fat grafting may be an emerging research trend worldwide. There were 3 studies related to implant-based breast reconstruction or breast augmentation, which could be a global emerging trend (14,15,20). Medication-related osteonecrosis of the jaw (13) and blindness after filler injection (12) could also be emerging study trends. According to the references in Chinese articles, cellular events, clinical applications, outcomes, and new products for fat grafting were studied (17,26-28). Therefore, fat grafting is an emerging research trend in China. In the field of head and neck reconstruction, computer-aided surgery and the use of anterolateral thigh flap are expected to become research trends in China (21,22,25). In addition, blindness after filler injections, extracellular matrix/stromal vascular fraction gel for stem cell therapy (23), and the wide-awake local anesthesia no tourniquet (WALANT) method in hand surgery (24) were shown to be emerging trends as well.

Discussion

There has been tremendous growth in the volume of plastic surgery research globally and in China. Though analyses of

Table 6 The ten most popular plastic surgery journals in eight countries [2010–2020]

Rank	United States		China		South Korea		Great Britain		Turkey		Germany		Japan		Italy	
	Journal (IF)	N	Journal (IF)	N	Journal (IF)	N	Journal (IF)	N	Journal (IF)	N	Journal (IF)	N	Journal (IF)	N	Journal (IF)	N
1	*Plast Reconstr Surg* (4.209)	3,351	*J Craniofac Surg* (0.953)	1,315	*J Craniofac Surg* (0.953)	1,011	*Brit J Oral Max Surg* (1.061)	966	*J Craniofac Surg* (0.953)	1,352	*J Cranio Maxill Surg* (1.766)	604	*J Craniofac Surg* (0.953)	320	*J Craniofac Surg* (0.953)	611
2	*J Hand Surg-Am* (2.124)	1,790	*Ann Plas Surg* (1.354)	547	*Ann Plas Surg* (1.354)	221	*J Plast Reconstr Aes* (2.39)	524	*Ann Plas Surg* (1.354)	153	*Brit J Oral Max Surg* (1.061)	128	*J Plast Reconstr Aes* (2.39)	271	*J Cranio Maxill Surg* (1.766)	196
3	*Ann Plas Surg* (1.354)	1,575	*Int J Oral Max Surg* (2.068)	337	*J Plast Reconstr Aes* (2.39)	194	*Burns* (2.066)	196	*J Cranio Maxill Surg* (1.766)	108	*J Plast Reconstr Aes* (2.39)	125	*Int J Oral Max Surg* (2.068)	200	*Int J Oral Max Surg* (2.068)	96
4	*J Craniofac Surg* (0.953)	1,341	*J Plast Reconstr Aes* (2.39)	317	*Dermatol Surg* (2.567)	179	*J Craniofac Surg* (0.953)	111	*Int J Oral Max Surg* (2.068)	94	*Int J Oral Max Surg* (2.068)	115	*J Hand Surg-Am* (2.124)	159	*Plast Reconstr Surg* (4.209)	91
5	*Dermatol Surg* (2.567)	1,105	*Plast Reconstr Surg* (4.209)	305	*Plast Reconstr Surg* (4.209)	169	*Int J Oral Max Surg* (2.068)	111	*J Plast Reconstr Aes* (2.39)	71	*Burns* (2.066)	88	*Ann Plas Surg* (1.354)	148	*J Plast Reconstr Aes* (2.39)	90
6	*Burns* (2.066)	437	*Brit J Oral Max Surg* (1.061)	274	*J Cranio Maxill Surg* (1.766)	142	*Plast Reconstr Surg* (4.209)	94	*Burns* (2.066)	57	*Plast Reconstr Surg* (4.209)	79	*J Cranio Maxill Surg* (1.766)	129	*Ann Plas Surg* (1.354)	83
7	*J Plast Reconstr Aes* (2.39)	381	*Burns* (2.066)	273	*J Hand Surg-Am* (2.124)	81	*Ann Plas Surg* (1.354)	80	*Brit J Oral Max Surg* (1.061)	52	*J Craniofac Surg* (0.953)	78	*Plast Reconstr Surg* (4.209)	122	*Brit J Oral Max Surg* (1.061)	76
8	*Int J Oral Max Surg* (2.068)	171	*J Cranio Maxill Surg* (1.766)	256	*Int J Oral Max Surg* (2.068)	77	*J Hand Surg-Am* (2.124)	59	*Plast Reconstr Surg* (4.209)	37	*Dermatol Surg* (2.567)	74	*Brit J Oral Max Surg* (1.061)	99	*Dermatol Surg* (2.567)	40
9	*J Cranio Maxill Surg* (1.766)	83	*Dermatol Surg* (2.567)	105	*Brit J Oral Max Surg* (1.061)	61	*J Cranio Maxill Surg* (1.766)	49	*Dermatol Surg* (2.567)	33	*Ann Plas Surg* (1.354)	68	*Burns* (2.066)	35	*J Hand Surg-Am* (2.124)	17
10	*Brit J Oral Max Surg* (1.061)	23	*J Hand Surg-Am* (2.124)	95	*Burns* (2.066)	46	*Dermatol Surg* (2.567)	23	*J Hand Surg-Am* (2.124)	25	*J Hand Surg-Am* (2.124)	51	*Dermatol Surg* (2.567)	35	*Burns* (2.066)	16
Total		10,257		3,824		2,181		2,213		1,982		1,410		1,518		1,316

IF, impact factor.

Table 7 The number and percentage of articles supported by funding in eight countries [2010–2020]

Year	United States, n (%)	China, n (%)	South Korea, n (%)	Great Britain, n (%)	Turkey, n (%)	Germany, n (%)	Japan, n (%)	Italy, n (%)
2010	292 (20.03)	89 (27.99)	48 (25.95)	22 (7.19)	10 (4.85)	21 (10.94)	54 (24.32)	5 (2.98)
2011	325 (23.40)	111 (33.94)	51 (25.25)	30 (10.45)	13 (6.25)	29 (14.29)	45 (22.28)	12 (7.64)
2012	338 (21.56)	148 (39.89)	74 (29.60)	38 (12.67)	14 (6.09)	30 (13.45)	63 (26.47)	9 (5.26)
2013	404 (25.00))	202 (43.53)	89 (31.12)	30 (9.93)	18 (6.57)	33 (16.10)	53 (22.36)	7 (3.55)
2014	435 (26.11)	205 (43.62)	116 (35.69)	36 (13.85)	22 (7.51)	36 (16.67)	69 (27.71)	16 (7.58)
2015	448 (27.07)	242 (45.15)	107 (34.85)	43 (17.84)	23 (8.42)	40 (16.06)	54 (28.88)	7 (4.32)
2016	436 (26.14)	213 (43.92)	107 (33.23)	48 (18.32)	27 (9.00)	35 (16.36)	47 (27.65)	18 (11.11)
2017	467 (27.83)	221 (46.43)	95 (30.94)	45 (18.15)	28 (10.85)	41 (18.81)	49 (28.49)	10 (5.81)
2018	477 (25.52)	262 (48.79)	100 (32.47)	48 (20.43)	27 (11.20)	35 (14.23)	39 (23.64)	9 (5.29)
2019	419 (21.82)	318 (51.88)	84 (29.58)	41 (19.71)	36 (12.41)	39 (19.40)	35 (16.59)	12 (6.67)
2020	367 (20.08)	376 (55.95)	89 (35.18)	62 (22.06)	31 (11.11)	36 (17.06)	26 (15.38)	14 (7.78)
Total	4,408 (24.07)	2,387 (45.30)	960 (31.69)	443 (15.12)	249 (8.73)	375 (15.77)	534 (24.03)	119 (6.17)

Table 8 Top keywords of clusters in the reference co-citation network of plastics surgery articles worldwide

Cluster	Mean year	Label (LSI)	Label (LLR)
0	2007	Breast reconstruction; computed tomography angiography; DIEA perforator flap; transit time flow volume; superficial inferior epigastric vein	Computed tomography angiography; free flap; preoperative planning; magnetic resonance angiography; perforator flap
1	2013	Breast reconstruction; CT angiography; complication; prepectoral implants; mastectomy flap necrosis	Outcomes; ACS-NSQIP; subpectoral; risk; direct to implant
2	2016	Fat grafting; fat transfer; S-curve butt lift; Brazilian butt lift; buttock	COVID-19; autologous fat transfer; aesthetic surgery; SARS-CoV-2; gluteal augmentation
3	2008	Breast reconstruction; complications; tissue expanders; acellular dermis; tissue expansion	Acellular dermal matrix; implants; ADM; alloderm; neopectoral pocket
4	2011	Adipose-derived stem cells; stromal vascular fraction; progenitor cells; endothelial cells; ultrastructure	Adipose-derived stem cells; lipoaspirate; lipotransfer; adipocytes; fat grafting
5	2011	Acellular dermal matrix; tissue expander; surgical mesh; breast surgery; matrix	Lymphedema; lymphaticovenular anastomosis; supermicrosurgery; cancer; indocyanine green (ICG)
6	2014	Lymphaticovenular anastomosis; supermicrosurgery; indocyanine green; to-side; intravascular stenting	Hyaluronic acid; fillers; blindness; soft tissue filler; breast reconstruction
7	2010	Hyaluronic acid; complications; ophthalmoplegia; vision loss; forehead augmentation	Acellular dermal matrix; seroma; implant; alloderm; tissue expander (TE)
8	2016	Breast; breast implants; implant-associated anaplastic large cell lymphoma; Asia syndrome; breast augmentation	Breast implant-associated anaplastic large cell lymphoma; BIA-ALCL; lymphoma; breast implants; spontaneous
9	2016	Fat grafting; cosmetic augmentation; mesenchymal stem cells; immune modulation; adipose stem cells	Microsurgery; enhanced recovery after surgery; quality of life; trauma; autologous
10	2011	Breast reconstruction; breast cancer; quality; life; external oblique flap	Capsular contracture; breast augmentation; magnetic resonance imaging; four-dimensional imaging; breast surgery
11	2008	Breast augmentation; capsular contracture; breast; breast reconstruction; povidone-iodine	Autologous fat grafting; autologous fat graft; tissue engineering; fat grafting; breast cancer

LSI, latent semantic indexing; LLR, log-likelihood ratio; DIEA, deep inferior epigastric artery; BIA-ALCL, breast-implant associated lymphoma.

Table 9 Top keywords of clusters in the reference co-citation network of Chinese plastic surgery articles

Cluster	Mean year	Label (LSI)	Label (LLR)
0	2013	Fat grafting; long term retention; muscle-derived stem cells; muscle augmentation; complication	Rejuvenation; micro-autologous fat transplantation (MAFT); fat graft; fat grafting; facial fat grafting
1	2008	Peroneal artery; pedicled perforator flap; propeller flap; foot reconstruction; free-tissue transfer	Free-tissue transfer; recipient vessels; recipient vein; medial sural artery; modified distally based medial fasciocutaneous flap
2	2015	Active motion; flexor tendon; pulley release; repair methods; secondary surgeries	Early active motion; flexor tendon; tendon repair; outcomes; carpal ligament injury
3	2011	Neck reconstruction; face; tissue expansion; pedicle flap; lateral thoracic flap	Face and neck reconstruction; perforator flap; tissue expansion; extremity reconstruction; lateral thoracic flap
4	2012	Orthognathic surgery; rapid prototyping; virtual planning; 2-jaw surgery; fibula flap	Orthognathic surgery; surgical navigation; virtual planning; rapid prototyping; surgical simulation
5	2016	Surgical technique; SVF-gel; Coleman technique; platelet-rich plasma; facial fat grafting	Coleman technique; acne scars; surgical scars; intense pulsed light; radiofrequency
6	2008	CT angiography; cheek; oromandibular defect reconstruction; anterolateral thigh flap; and-through defect	Oromandibular defect reconstruction; thoracodorsal; oral cavity cancer; local flap; facial defects
7	2009	Free toe pulp flap; digital pulp reconstruction; free neurovascular flap; finger pulp defect; finger-pulp reconstruction	Finger-pulp reconstruction; sensate flap; arterialised venous flap; sensorial morbidity; finger pulp defect
8	2009	Fibular osteomyocutaneous flap; virtual surgical planning; secondary maxillary reconstruction; midface; maxilla	Fibular osteomyocutaneous flap; maxillofacial reconstruction; virtual surgical planning; surgical planning and simulation; reconstructive surgical
9	2016	Orthognathic surgery; cleft lip; multidisciplinary approach; patient-centered care; reconstructive surgery	Cleft lip; 3d simulation; orthognathic surgery; mirroring; single-splint technique
10	2007	Proximal phalanx; reverse island flap; second dorsal branch; proper digital artery; middle phalanx	Defect; dorsal metacarpal artery; pedicled osteoarticular flap; reverse island flap; capitate
11	2008	Temporomandibular joint ankylosis; condyle reconstruction; transport distraction osteogenesis	Transport distraction osteogenesis; condyle reconstruction; temporomandibular joint ankylosis; orthognathic surgery; microsurgery

LSI, latent semantic indexing; LLR, log-likelihood ratio; SVF, stromal vascular fraction.

Chinese contributions to various surgical specialties, such as orthopedics (6), otorhinolaryngology (5), obstetrics, and gynecology (4), have been performed previously, articles detailing Chinese achievements in plastic surgery are almost a decade old (7,8). Zhang *et al.* (7) studied plastic surgery publications from 2000 to 2009, demonstrating a substantial increase in Chinese contributions to the 6 selected high-impact journals. Their second literature survey revealed Chinese contributions in the same plastic surgery journals from 2005 to 2009 (8). Our bibliometric study included a more comprehensive journal list and traced the trends in plastic surgery publications between 2010 and 2020. Such findings are indicators of plastic surgery research trends and are useful for future funding allocations.

The United States came first in both the number and percentage share of publications. The past 11 years have witnessed continuous annual growth in the number of plastic surgery articles from China. The trend is consistent with a previous study of publications from 2000 to 2009 (7), which reflected the rapid development of plastic surgery. From 2010 to 2020, an increasing number of articles from China were supported by funding from various sources, and the rate has increased by 50% since 2019. These results suggest that China is supporting plastic surgery academia by increasing funding expenditure. In addition, the rapid growth of the Chinese GDP could result in more surgical procedures, especially cosmetic, being performed, resulting in a large and accessible research cohort (29). A promising

Table 10 References of plastic surgery articles worldwide with citation burst in 2019–2020 in descending order of strength

References	Strength	Topic
Tang JB, 2016, *J Hand Surg Eur Vol* (10)	43.48	Why and how to report surgeons' levels of expertise
[Anonymous], 2017, *Aesthet Surg J* (11)	27.09	Data of cosmetic procedures performed in the United States from 1997 to 2016
Beleznay K, 2015, *Dermatol Surg* (12)	24.1	Review of blindness after filler injection
Ruggiero SL, 2014, *J Oral Maxillofac Surg* (13)	24.01	Practice guideline on medication-related osteonecrosis of the jaw
Sigalove S, 2017, *Plast Reconstr Surg* (14)	22.19	The rationale, indications/contraindications and results of prepectoral implant-based breast reconstruction
Hu H, 2016, *Plast Reconstr Surg* (15)	21.77	Research on the bacterial biofilm present in breast implant-associated anaplastic large-cell lymphoma
Mofid MM, 2017, *Aesthet Surg J* (16)	17.96	Report on mortality from gluteal fat grafting
Kato H, 2014, *Plast Reconstr Surg* (17)	17.87	Research on cellular events after fat grafting
Strong AL, 2015, *Plast Reconstr Surg* (18)	15.76	Review of harvesting, processing, and injection techniques of fat grafting
Cárdenas-Camarena L, 2015, *Plast Reconstr Surg* (19)	14.74	Analysis of secondary deaths from gluteal lipoinjection
Spear SL, 2014, *Plast Reconstr Surg* (20)	11.86	The 10-year study results of Natrelle round silicone-filled breast implants

Table 11 References of Chinese plastic surgery articles with citation burst in 2019–2020 in descending order of strength

References	Strength	Topic
Kato H, 2014, *Plast Reconstr Surg* (17)	8.5	Research on cellular events after fat grafting
Tang JB, 2016, *J Hand Surg Eur Vol* (10)	5.77	Why and how to report surgeons' levels of expertise
Beleznay K, 2015, *Dermatol Surg* (12)	5.11	Review of blindness after filler injection
Ho CT, 2017, *Sci Rep* (21)	5.02	Three-dimensional surgical simulation improves the planning for correction of facial prognathism and asymmetry
Lonic D, 2016, *PLoS One* (22)	5.02	Research on computer-assisted orthognathic surgery for cleft lip/palate patients
Yao Y, 2017, *Plast Reconstr Surg* (23)	4.51	Research on the therapeutic potential of extracellular matrix/stromal vascular fraction gel
Lalonde DH, 2017, *J Hand Surg Eur Vol* (24)	4.03	Review of wide-awake hand surgery
Lee YC, 2015, *Plast Reconstr Surg* (25)	4.03	Anatomical variability of the anterolateral thigh flap perforators
Zhang YT, 2018, *Plast Reconstr Surg* (26)	4.01	Research on the retention and regeneration mode of stromal vascular fraction gel grafting
Khouri RK, 2017, *Plast Reconstr Surg* (27)	3.8	Principles and techniques of fat grafting
Mineda K, 2014, *Plast Reconstr Surg* (28)	3.8	Research on chronic inflammation and calcification after fat necrosis in autologous fat grafting to the breast

future trend of more funding awaits, encouraging more Chinese surgeons to apply themselves to this field.

We calculated journal IFs by dividing the number of citations in 2019 for articles published in 2017 and 2018 by the number of substantive articles and reviews published in 2017 and 2018 (30). Although we only used data from 2 years to calculate the IFs, we presumed that they were consistent with a 5-year IF (9) and positively correlated with

a 50-year IF (31), thus reflecting the quality of the journals over a long period.

The average IF of Chinese articles was at the forefront worldwide, indicating that Chinese articles have been published in high-quality journals. However, we also noticed a considerable gap between the average IF for China, the United States, and Japan. The rank of total citations was similar to that of the cumulative IFs, with China ranking second to the United States. However, articles from China had a lower citation count when compared to the United States, Great Britain, Japan, and Italy. Furthermore, China contributed less than the United States to the 10 journals with the highest IFs. It was discouraging to note that the quality of articles from China lagged behind in terms of quantity compared to developed countries.

We noticed discrepancies between the average IFs and citation counts. There are several possible explanations for this. First, reviews tend to have higher citation counts than original articles, resulting in citation count figures for an individual article that are higher than the corresponding journal's IF. Secondly, the difference could also be attributed to citation skew. Asaad *et al.* (32) assessed the citation distribution of articles published in 33 plastic surgery journals between 2016 and 2017. Their findings demonstrated that 66% of articles had a citation count lower than their journal's IF, and that only 12.6% of articles contributed to 50% of citations.

The *Journal of Craniofacial Surgery* was the most popular journal among the Asian countries studied, namely, China, Turkey, South Korea, and Japan. According to a study by Liechty *et al.* (2), Asia was the main contributor to this journal, producing 55.8% of its total publication in the 2010s. In addition, we noted 7 of the analyzed countries published most of their articles in journals specializing in craniofacial surgery. In comprehensive plastic surgery journals, articles discussing head and neck reconstruction accounted for the highest proportion of publications in 2006 to 2016 (33). These results suggest that craniomaxillofacial surgery has been at the forefront of plastic surgery developments.

The intellectual integrity was identified via the co-citation network. We listed major clusters according to their number of members. The most recent clusters were indicative of the emerging trends.

These emerging trends were also predicted using the references with the strongest citation bursts in 2019 and 2020. Fat grafting and blindness after filler injection were shown to be emerging trends worldwide, including in China. Globally, implant-based breast surgery and osteonecrosis of the jaw are also expected to become research trends. In addition, research trends in China included computer-aided maxillofacial surgery, anterolateral thigh flap in head and neck reconstruction, extracellular matrix/stromal vascular fraction gel for stem cell therapy, and WALANT hand surgery.

The current study performed bibliometric analysis of 55,554 articles in 35 plastic surgery journals; however, the study had several limitations. Interdisciplinary research published in journals not specializing in plastic surgery, for example, the study of bone development and repair mechanisms published in *Nature Reviews Molecular Cell Biology* (34), was not analyzed. Since there is not a 'plastic surgery' category in the SCIE database, our study might not have included all the plastic surgery journals. However, with a total of 35 plastic surgery journals analyzed in our study, it is not likely the publication trends would be significantly different.

Conclusions

Our analysis demonstrated the rapid expansion and trends of plastic surgery research worldwide and in China. While the United States was the most productive country in terms of research, China contributed a considerable number of articles to the field, many of which were supported by funding. The quality of the articles from China did not equal their quantity. This study may indicate possible research trends in the future and promote further support for plastic surgeons who are pursuing careers in research.

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Footnote

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aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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