



Face transplantation: a bibliometric analysis of the top 100 most cited articles

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Abstract

Background Since the first face transplant procedure was performed in 2005, hundreds of publications have been published on the topic. In this bibliometric analysis we identify the key influential studies, based on citation power, in the field of face transplantation and summarize their content and characteristics.

Methods The Clarivate Analytics' Web of Science database was searched for the topic "face transplantation." We applied no limitations on publication date, language, or article length. The top 100 publications accruing the most citations were identified and information on title, year, journal, first and corresponding author, institution, country of corresponding author, methodology, and topic focus were extracted.

Results Of the top 100, most papers were published in 2011 ($n = 11$), with the publication years ranging between 2002 and 2019. Eight themes were identified, including ethics and psychology and post-operative outcomes. The most common theme was post-operative outcomes. Most publications had a clinical focus ($n = 67$), with only 11 being basic science. The country with the highest number of publications was the USA ($n = 68$), pooling a total of 3509 citations. The department with the highest number of publications was the Department of Plastic Surgery of Cleveland Clinic ($n = 22$).

Conclusion This analysis outlines the most influential publications in the field of face transplantation, providing a novel perspective on the field. These 100 publications reflect the progression of the field and outline significant advances in face transplantation. The analysis summarizes the trends occurring in the field and can help guide future academic research. Level of evidence: Not ratable.

Keywords Facial transplantation · Transplant · Reconstructive surgery · Vascularized composite allotransplantation · Bibliometrics · Citation

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Introduction

Since the first face transplant in 2005, no more than 47 such procedures have been carried out worldwide [1, 2]. Despite the relative infancy of the field and in contrast to the small number of completed procedures, hundreds of studies have been published on the topic, covering themes from surgical technique and post-operative outcomes to the psychological and ethical implications of the procedure.

This disproportionate research productivity in the field of face transplantation is in line with the exponential growth of academic research in general. Owing to this, various metrics and measurement tools have been developed to assist in categorizing the publications, particularly with regard to the influence they have on their respective field. One such tool is bibliometric analysis. Coined by Pritchard in 1969, bibliometrics is a quantitative evaluation of publications, including the journal, author, and the number of citations, that is, the number of times these are cited in publications written by other scientists [3]. The impact of a scientific publication, particularly in recent years, is evaluated based on the number of citations it accrues. However, the ranking created by such bibliometric analysis is based on the scientific interest shown by other researchers rather than on the actual quality of the studies assessed. Regardless, the most frequently cited studies are also essential papers of high methodological quality and, therefore, of high scientific merit [4]. Broadly, the general assumption is that the number of citations directly reflects the impact of a paper. [5]

Bibliometric analyses have been previously conducted to identify the most cited publications in multiple surgical specialties, including in general surgery [6], transplantation [7], orthopedics [8, 9], robotics [10], pediatric surgery [11], plastic surgery [12], hand surgery [13], and oral and maxillofacial surgery. [14, 15]

A 2022 study by Hoffman et al. evaluated the entire body of face transplantation literature and identified trends in the publications over time [16]. A limitation of this study, as stated by the authors, was that, given their methodology, they did not consider the quality of publications, treating all publications as equivalent. To date, no bibliometric analysis has focused on the most influential—based on citation power—literature pertaining to face transplantation. In this bibliometric analysis, we analyze the most-cited papers in the field of face transplantation with the aim to obtain a better understanding of the traits and characteristics that render such research influential.

Methods

Following the methodology for bibliometric analysis from prior publications [9, 17, 18], the term “face transplantation” was used to search the “Topic” field of the Clarivate Analytics’ Web of Science database (available at <https://www.webofscience.com/woscc>). The “Topic” field searches the title, abstract, author keywords, and Keywords Plus of publications. The search was performed on April 1, 2022, and no limitations on publication date, language, article type, or article length were applied. The obtained dataset was downloaded and sorted by the number of citations in Microsoft Excel® 2020 (Microsoft, Redmond, WA, USA) and the 100 most cited publications were identified according to the selection process in Fig. 1.

During evaluation of the publications, the title, first and corresponding author, year of publication, the number of citations, publishing institution, journal, journal impact factor, and the country of origin of each manuscript were recorded. The publishing institution and country of origin were determined from the information listed for the corresponding author. The citation density was calculated by dividing the total number of citations by the number of years since publication. The journal impact factor was the latest available impact factor, as listed on the website of each respective journal. Information on the publishing model of journals (open, subscription, or hybrid) was also obtained. The content was analyzed, and a methodological design and corresponding level of evidence (LoE) were assigned to each publication. Publications were

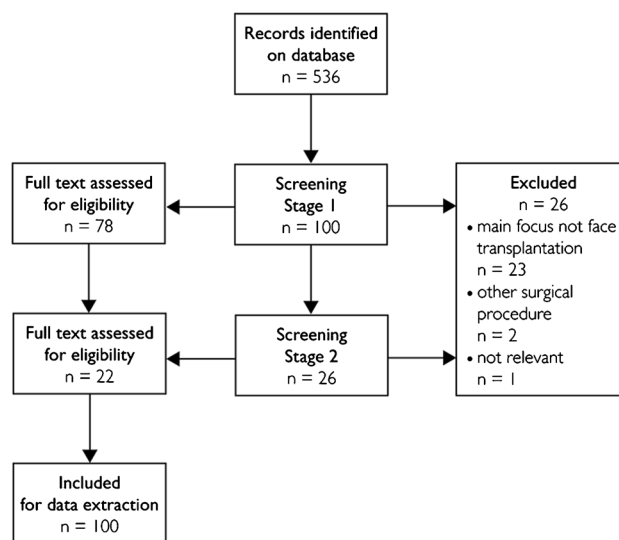


Fig. 1 Study selection process

Table 1 The 100 most cited publications with a focus on face transplantation

Rank	Title	First author	Corresp. author	Year	Citations	Citation density
1	Outcomes 18 months after the first human partial face transplantation [19]	Dubernard	Dubernard	2007	305	20.3
2	Near-total human face transplantation for a severely disfigured patient in the USA [25]	Siemionow	Siemionow	2009	238	18.3
3	Repair of the lower and middle parts of the face by composite tissue allotransplantation in a patient with massive plexiform neurofibroma: a 1-year follow-up study [26]	Lantieri	Lantieri	2008	237	16.9
4	Human facial allotransplantation: a 2-year follow-up study [27]	Guo	Guo	2008	218	15.6
5	Three patients with full facial transplantation [28]	Pomahac	Pomahac	2012	184	18.4
6	Facial transplantation: the first 9 years [21]	Khalifian	Rodriguez	2014	168	21.0
7	Feasibility, reproducibility, risks and benefits of face transplantation: a prospective study of outcomes [29]	Lantieri	Lantieri	2011	160	14.5
8	First US near-total human face transplantation: a paradigm shift for massive complex injuries [30]	Siemionow	Siemionow	2010	128	10.7
9	Restoration of facial form and function after severe disfigurement from burn injury by a composite facial allograft [31]	Pomahac	Pomahac	2011	116	10.5
10	The world's experience with facial transplantation what have we learned thus far? [32]	Gordon	Gordon	2009	114	8.8
11	Tolerance induction in composite facial allograft transplantation in the rat model [33]	Demir	Siemionow	2004	95	5.3
12	On the ethics of facial transplantation research [34]	Wiggins	Wiggins	2004	92	5.1
13	First human face transplantation: 5 years outcomes [35]	Petruzzo	Petruzzo	2012	86	8.6
14	The face transplantation update: 2016 [36]	Sosin	Rodriguez	2016	80	13.3
15	An update on facial transplantation cases performed between 2005 and 2010 [37]	Siemionow	Siemionow	2011	77	7.0
16	Face transplantation: A review of the technical, immunological, psychological and clinical issues with recommendations for good practice [38]	Morris	Morris	2007	76	5.1
17	The management of antibody-mediated rejection in the first presensitized recipient of a full-face allotransplant [39]	Chandraker	Chandraker	2014	74	9.3
18	Composite tissue allotransplantation of the hand and face: a new frontier in transplant and reconstructive surgery [40]	Gander	Barker	2006	74	4.6
19	Face transplantation: outcomes, concerns, controversies, and future directions [41]	Siemionow	Siemionow	2012	72	7.2
20	Functional outcomes of face transplantation [42]	Fischer	Pomahac	2015	68	9.7
21	Functional tolerance following face transplantation in the rat [43]	Siemionow	Siemionow	2003	67	11.2
22	Total face, eyelids, ears, scalp, and skeletal subunit transplant: a reconstructive solution for the full face and total scalp burn [44]	Sosin	Rodriguez	2016	67	3.5
23	Face transplantation: partial graft loss of the first case 10 years later [45]	Morelon	Petruzzo	2017	66	13.2
24	Surgical aspects of a lower face, mandible, and tongue allotransplantation [46]	Cavadas	Cavadas	2012	62	6.2
25	Face transplantation—fantasy or the future? [23]	Hettiaratchy	Butler	2002	62	3.1
26	Face transplantation: where do we stand? [47]	Petit	Petit	2004	56	3.1
27	Development and maintenance of donor-specific chimerism in semi-allogenic and fully major histocompatibility complex mismatched facial allograft transplants [48]	Siemionow	Siemionow	2005	53	3.1
28	Acute rejection in vascularized composite allotransplantation [49]	Fischer	Pomahac	2014	52	6.5
29	Overview of guidelines for establishing a face transplant program: a work in progress [50]	Siemionow	Gordon	2010	52	4.3
30	Psychosocial implications of disfigurement and the future of human face transplantation [51]	Furr	Barker	2007	51	5.7
31	Vascularized composite allotransplantation: an update on medical and surgical progress and remaining challenges [52]	Murphy	Borschel	2013	51	4.3
32	Institutional review board-based recommendations for medical institutions pursuing protocol approval for facial transplantation [53]	Siemionow	Gordon	2010	51	3.4
33	Face, upper extremity, and concomitant transplantation: potential concerns and challenges ahead [54]	Siemionow	Siemionow	2010	49	4.1
34	Investigation of risk acceptance in facial transplantation [55]	Barker	Barker	2006	47	3.4
35	Face as an organ [56]	Siemionow	Siemionow	2008	47	2.9
36	Evolution of indications for facial transplantation [57]	Pomahac	Pomahac	2011	46	4.2
37	Pathways of sensory recovery after face transplantation [58]	Siemionow	Siemionow	2011	46	4.2
38	Prospects for facial allograft transplantation in humans [59]	Siemionow	Siemionow	2004	46	2.6
39	Novel surgical technique for full face transplantation [60]	Pomahac	Pomahac	2012	44	4.4
40	Clinical outcomes of facial transplantation: a review [61]	Shanmugarajah	Butler	2011	44	4.0

Table 1 (continued)

Rank	Title	First author	Corresp. author	Year	Citations	Citation density
41	Psychological outcomes with face transplantation: overview and case report [62]	Coffman	Coffman	2010	44	3.7
42	Psychological aspects of face transplantation: read the small print carefully [63]	Rumsey	Rumsey	2004	43	2.4
43	Complex facial reconstruction by vascularized composite allotransplantation: the first Belgian case [64]	Roche	Roche	2015	42	6.0
44	A multidisciplinary protocol for face transplantation at Brigham and Women's Hospital [65]	Bueno	Pomahac	2011	42	3.8
45	Cost analysis of conventional facial reconstruction procedures followed by face transplantation [66]	Siemionow	Siemionow	2011	42	3.8
46	Face transplantation: psychological outcomes at three-year follow-up [67]	Coffman	Coffman	2013	41	4.6
47	Successes and lessons learned after more than a decade of upper extremity and face transplantation [68]	Siemionow	Siemionow	2013	41	4.6
48	A position paper in support of face transplantation in the blind [69]	Carty	Carty	2012	39	4.3
49	Current concepts and future challenges in facial transplantation [70]	Lengel�e	Lengel�e	2009	39	3.9
50	Current principles of facial allotransplantation: the Brigham and Women's Hospital experience [71]	Pomahac	Bueno	2013	39	3.0
51	The decade of face transplant outcomes [72]	Siemionow	Siemionow	2017	38	7.6
52	Facial allotransplantation: a 3-year follow-up report [73]	Diaz-Siso	Pomahac	2013	37	4.1
53	Coronal-posterior approach for face/scalp flap harvesting in preparation for face transplantation [74]	Siemionow	Siemionow	2006	36	4.0
54	Infections following facial composite tissue allotransplantation—single center experience and review of the literature [75]	Knoll	Marty	2013	36	2.3
55	Cytomegalovirus and other infectious issues related to face transplantation: specific considerations, lessons learned, and future recommendations [76]	Gordon	Gordon	2011	35	3.5
56	Facial transplantation [77]	Shanmugarajah	Butler	2012	35	3.2
57	Evolution of ethical debate on face transplantation [78]	Kiwanuka	Pomahac	2013	34	3.8
58	Technical and anatomical considerations of face harvest in face transplantation [79]	Baccarani	Erdmann	2006	34	2.1
59	New surgical approach in facial transplantation extends survival of allograft recipients [80]	Unal	Siemionow	2005	34	2.0
60	Face transplant: a paradigm change in facial reconstruction [81]	Lantieri	Lantieri	2012	33	3.3
61	Psychosocial changes 6 months after face transplantation [82]	Chang	Chang	2013	32	3.6
62	Quality of life after face transplantation: outcomes, assessment tools, and future directions [83]	Aycart	Oser	2017	31	6.2
63	Utility of sentinel flaps in assessing facial allograft rejection [84]	Kueckelhaus	Pomahac	2015	31	4.4
64	Face transplantation: when and for whom? [85]	Butler	Butler	2004	31	1.7
65	The issue of facial appearance and identity transfer after mock transplantation: a cadaver study in preparation for facial allograft transplantation in humans [86]	Siemionow	Siemionow	2006	30	3.8
66	Aesthetic and functional facial transplantation: a classification system and treatment algorithm [87]	Mohan	Rodriguez	2014	30	2.7
67	Reconstruction of a severe facial defect by allotransplantation in neurofibromatosis type 1: a case report [88]	Sicilia-Castro	Gacto-Sanchez	2011	30	1.9
68	Risk assessment of immunosuppressive therapy in facial transplantation [89]	Vasilic	Barker	2007	29	1.9
69	Some issues in facial transplantation [90]	Chenggang	Shuzhong	2008	28	2.3
70	On the ethics of composite tissue allotransplantation (facial transplantation) [91]	Rohrich	Rohrich	2006	28	2.0
71	Psychosocial considerations in facial transplantation [92]	Soni	Barker	2010	28	1.8
72	Total face, eyelids, ears, scalp, and skeletal subunit transplant cadaver simulation: the culmination of aesthetic, craniofacial, and microsurgery principles [44]	Sosin	Rodriguez	2016	27	4.5
73	Face transplantation program in France: a cost analysis of five patients [93]	Ruegg	Ruegg	2012	27	2.7
74	Facial transplantation in a blind patient: psychologic, marital, and family outcomes at 15 months follow-up [94]	Lemmens	Lemmens	2015	26	6.5
75	A statistical comparative assessment of face and hand transplantation outcomes to determine whether either meets the standard of care threshold [95]	Breidenbach	Breidenbach	2016	26	4.3
76	A new composite midface allotransplantation model with sensory and motor reinnervation [96]	Zor	Siemionow	2010	26	3.7
77	Face transplantation: current status and future developments [97]	Tasigiorgos	Pomahac	2018	26	2.2
78	A surgeons' perspective on the ethics of face transplantation [98]	Petit	Petit	2004	26	2.2
79	Evaluation of appearance transfer and persistence in central face transplantation: a computer simulation analysis [99]	Pomahac	Pomahac	2010	26	1.4
80	The Helsinki face transplantation: surgical aspects and 1-year outcome [100]	Lassus	Lassus	2018	25	6.3
81	Codominant role of interferon- and interleukin-17-producing T cells during rejection in full facial transplant recipients [101]	Borges	Riella	2016	25	4.2

Table 1 (continued)

Rank	Title	First author	Corresp. author	Year	Citations	Citation density
82	Facial transplantation: a comprehensive review of the literature	Taure	Meningaud	2006	25	1.6
83	Logistics and strategy of multiorgan procurement involving total face allograft	Bueno	Bueno	2011	24	8.0
84	Five-year follow-up after face transplantation [102]	Tasigiorgos	Pomahac	2019	24	3.4
85	Cost analysis of conventional face reconstruction versus face transplantation for large tissue defects	Nguyen	Nguyen	2015	24	2.7
86	CT angiography for surgical planning in face transplantation candidates [103]	Soga	Rybicki	2013	24	2.2
87	Face transplantation [104]	Dubernard	Dubernard	2008	24	1.7
88	Face allotransplantation for various types of facial disfigurements: a series of five cases [105]	Özkan	Özkan	2018	23	5.8
89	Le fort-based maxillofacial transplantation: current state of the art and a refined technique using orthognathic applications [106]	Gordon	Gordon	2012	23	2.3
90	Developing a canine model of composite facial/scalp allograft transplantation [107]	Shengwu	Qingfeng	2007	23	1.5
91	Ethical considerations in the first American face transplant [108]	Paradis	Paradis	2010	22	3.7
92	The role of face transplantation in the self-inflicted gunshot wound [109]	Kiwanuka	Pomahac	2016	22	3.1
93	Facial transplantation: history and update [110]	Roche	Roche	2015	22	1.8
94	Facial transplantation: worth the risks? A look at evolution of indications over the last decade [111]	Wo	Pomahac	2015	21	4.2
95	Ethics of facial transplantation revisited [112]	Coffman	Coffman	2014	21	3.5
96	Long-term multifunctional outcome and risks of face vascularized composite allotransplantation [113]	Roche	Roche	2015	21	3.0
97	Facial transplantation: a concise update [114]	Infante-Cossio	Infante-Cossio	2013	21	3.0
98	Face transplantation: part II—an ethical perspective [22]	Clark	Clark	2005	21	2.6
99	Reflections on a decade of face transplantation [115]	Giatsidis	Giatsidis	2017	21	2.3
100	A retrospective analysis of secondary revisions after face transplantation: assessment of outcomes, safety, and feasibility [20]	Aycart	Pomahac	2016	21	1.2

Corresp, Corresponding; Citation density, mean number of citations per year

categorized into one of three broad categories: clinical, basic science, and other, for publications that did not have a clear clinical or basic science focus. Categories of subject foci were also identified.

Graphical presentation was performed in GraphPad Prism (Version 8.00; MacOS, GraphPad Software, La Jolla, CA, USA).

Results

The initial database search returned 536 full-length publications (Fig. 1). The top 100 most cited publications are summarized in Table 1. The number of citations of the top 100 cited publications ranged from 305 (“Outcomes 18 months after the first human partial face transplantation” Dubernard et al. [19]) to 21 (“A retrospective analysis of secondary revisions after face transplantation: assessment of outcomes, safety, and feasibility” Aycart et al. [20]). Citation density ranged from 21 citations/year (“Facial transplantation: the first 9 years” Khalifian et al. [21])

to 1.2 citations/year (“Face transplantation: part II—an ethical perspective” Clark [22]). The oldest publication included on the list, “Face transplantation—fantasy or the future?,” by Hettiaratchy and Butler [23] was published in 2002, 3 years before the first successful face transplant. The most recent publication, “Five-year follow-up after face transplantation,” was published in 2019 by Tasigiorgos et al. [24]

On content analysis eight subject foci were identified: anatomy, ethics and psychology, immunosuppression and rejection, post-operative outcomes, pre-operative preparation and surgical procedure, prognosis and risks, public health and costs, and update of previous literature (Fig. 2). The most common subject foci were post-operative outcomes and updates, with a total of 23 papers each, followed by ethics and psychology, with a total of 16 papers (Table 1, Fig. 2). The least common focus was anatomy with two papers [56, 58]. Furthermore, six out of 10 of the most cited publications focused on post-operative outcomes [19, 25–27, 29, 31]. Most publications had a clinical focus ($n = 67$), followed by

Fig. 2 Study-type analysis. **a, b** Top 100 cited papers by subject focus. **c** Total number of citations versus type of study. No significant differences in number of citations were identified between the three types of study ($p=0.12$)

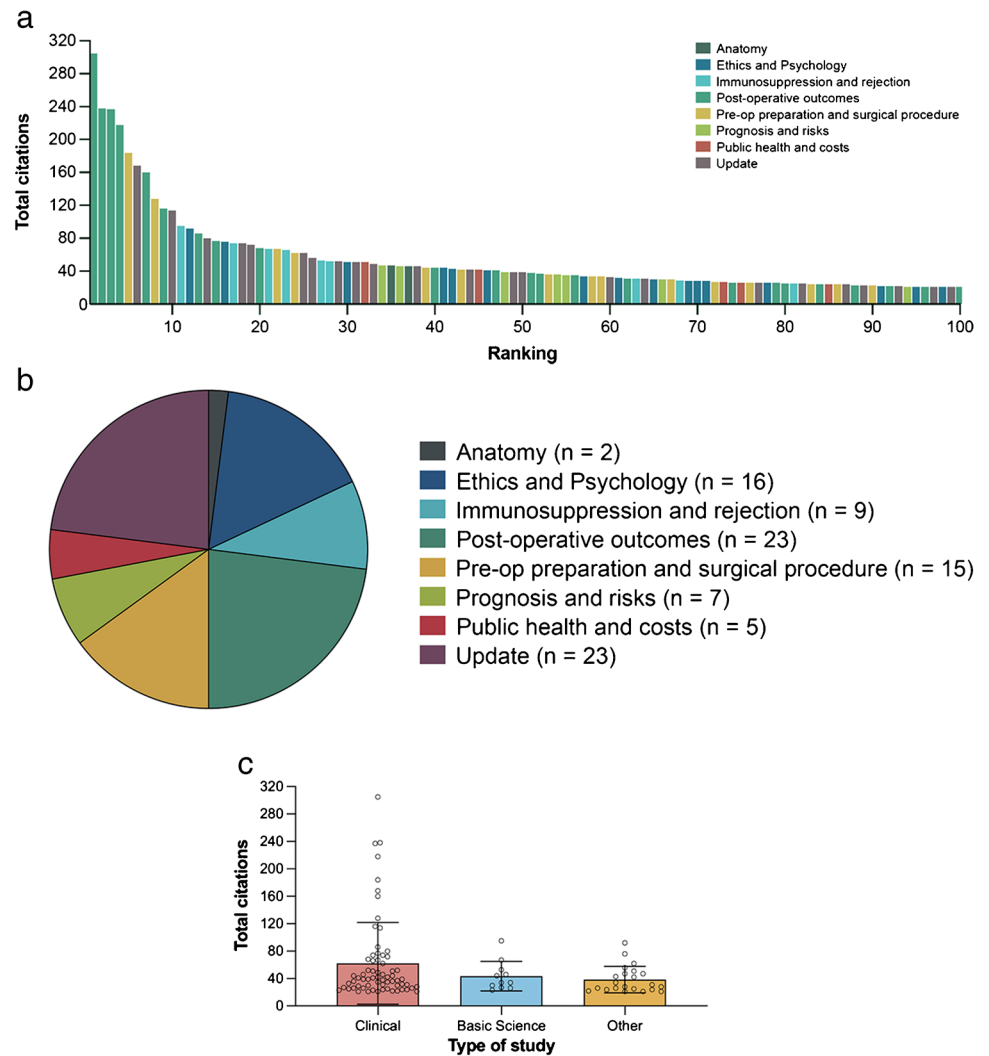


Table 2 Number of papers for each level of evidence (LoE) and type of study. No significant correlation was identified between LoE and number of citations ($p=0.77$)

Type of study	Number of papers
LoE IV	4
Case control	3
Prospective cohort	1
LoE V	41
Case series	12
Reviews and meta-analyses	29
LoE VI	36
Cadaver study	5
Case report	24
Animal research	7
LoE VII	19
Ideas, editorials, and opinions	19

other ($n=22$), and basic science ($n=11$). Of the 11 basic science studies, four were cadaver studies [44, 60, 79, 86] and seven were animal studies. [33, 43, 48, 59, 80, 96, 107]

The majority of studies had a LoE of V ($n=41$), followed by VI ($n=36$), and VII ($n=19$). Only four studies had a LoE of IV (Table 2) [29, 55, 99, 116]. Most studies were reviews and meta-analyses ($n=29$), followed by case reports ($n=24$), and ideas, editorials, and opinions ($n=19$). Only one prospective cohort was found. [29]

The top five countries with the highest number of influential papers were the USA ($n=68$), France ($n=10$), the UK ($n=6$), Belgium ($n=5$) and Spain ($n=4$). The order was different when the total citations per country were pooled, with the USA having a total of 3509 citations, followed by France with 979 citations, the UK with 291, China with 269, and Belgium with 150 (Fig. 3).

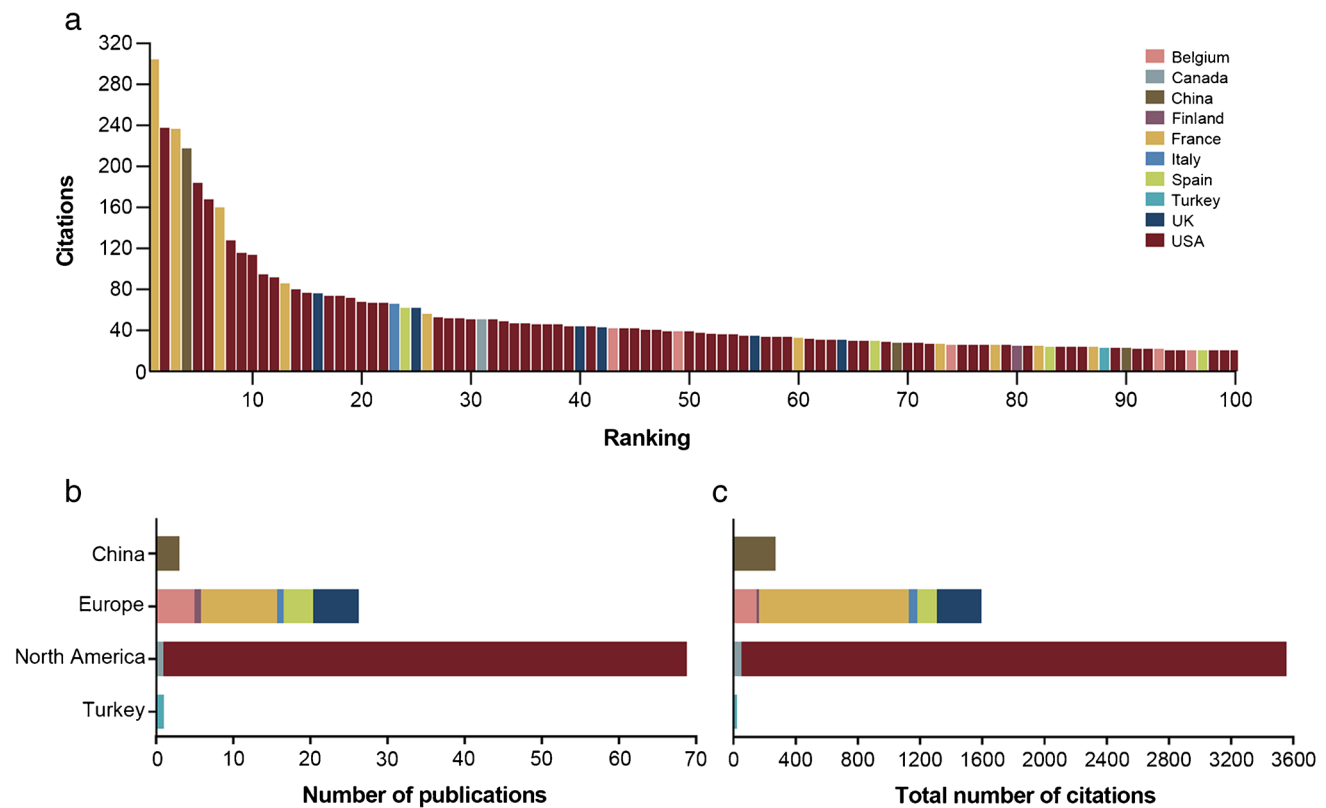


Fig. 3 Country analysis. **a** Top 100 cited papers by country. **b** Total number of publications in the top 100 per region. **c** Total number of citations per region. Country selected based on institution of corresponding author

The year with the highest number of influential papers was 2011 ($n=11$), followed by 2012 and 2013 ($n=10$ each). Six of the top 10 most cited publications were published in the 5-year period between 2006 and 2010, [19, 25–27, 30, 32] indicating that the oldest papers were not the most cited (Fig. 4).

The top 100 manuscripts were published in 26 journals (Table 3). *Plastic and Reconstructive Surgery* published the majority of papers ($n=27$), followed by *American Journal of Transplantation* ($n=11$), *Journal of Plastic Reconstructive and Aesthetic Surgery* ($n=8$), and *Lancet* ($n=6$). The journals' impact factor (IF) ranged from 1.05 to 91.25. A positive correlation between journal IF and total citations was identified ($R^2=0.4525$, $p<0.0001$; Fig. 5). Four of the journals are open access (*Psychosomatics*, *Journal of Materials Science-Materials in Medicine*, *Medicina Oral*, *Patologia Oral*, *Cirurgia*, and *Bucal Medical Science Monitor*). The remaining journals are hybrid journals, and of the 100 publications, 30 were published open access and 70 by subscription.

The department with the highest number of publications in the top 100 was the Department of Plastic Surgery of Cleveland Clinic ($n=22$), followed by the Division of

Plastic Surgery, Department of Surgery, of Brigham and Women's Hospital ($n=20$). Of the top 11 institutions with the most publications in the top 100, six are based in the USA, two in France, one in the UK, one in Belgium, and one in China (Table 4).

Dr. Maria Siemionow had the highest number of corresponding author publications in the top 100 ($n=18$), followed by Dr. Bohdan Pomahac ($n=16$; Table 5). The top 10 most influential publications were published by six corresponding authors, with Dr. Maria Siemionow, Dr. Bohdan Pomahac, and Dr. Laurent Lantieri each contributing two publications.

Discussion

This bibliometric analysis reflects the evolution of the field of face transplantation which transitioned from hypothesis to reality. The 12 earliest publications in the top 100, which were published before the first successful first transplant in 2005, focused on outlining the ethics of the procedure and contemplated whether such a

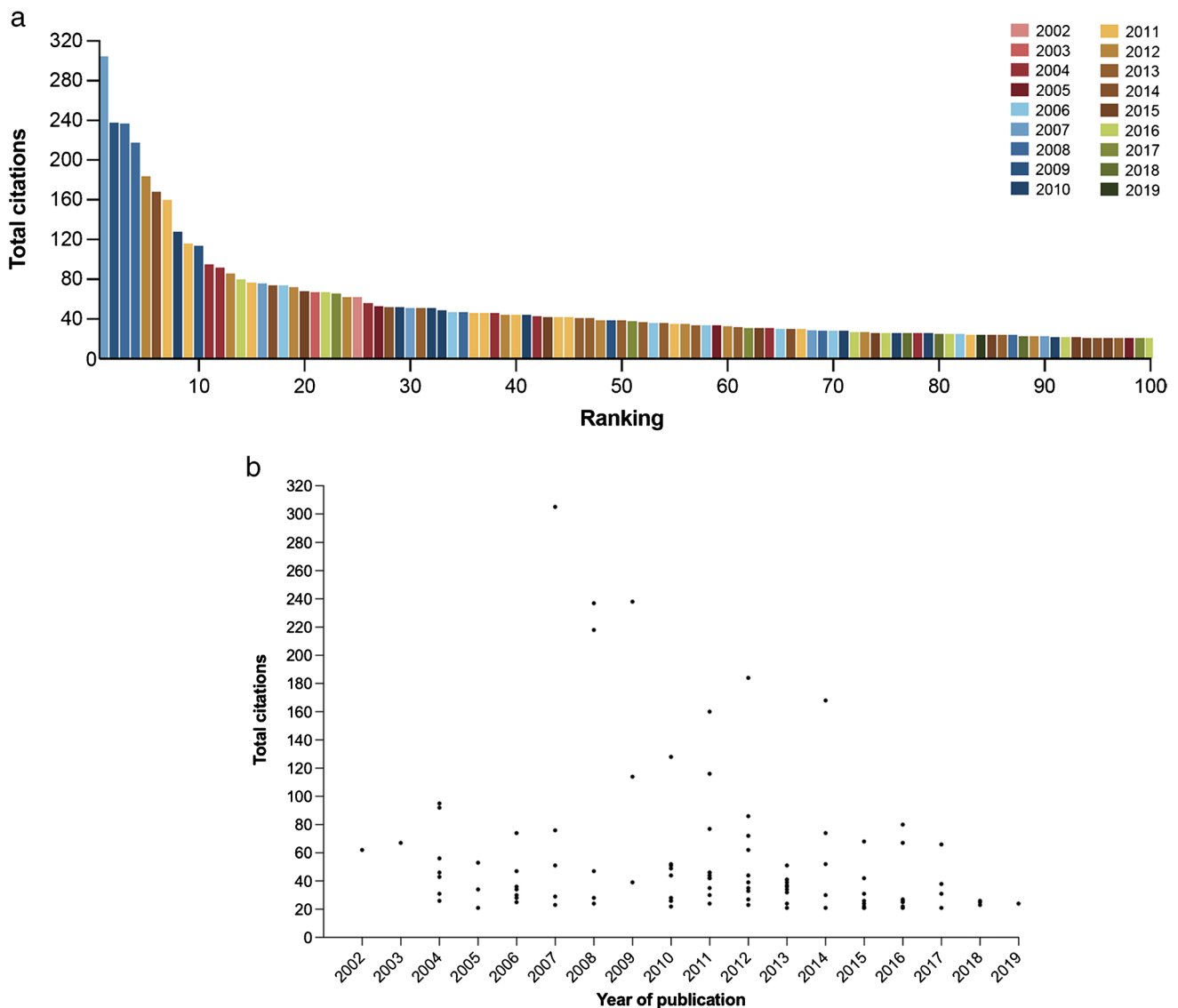


Fig. 4 Year analysis. **a** Top 100 cited papers by year of publication. **b** Correlation between the publications' number of citations and year of publication. No significant correlation was identified between year of publication and number of citations ($p=0.05$)

procedure should solely be considered a “fantasy.” The success of the first face transplant was then followed by multiple case reports outlining the pre-operative preparation and peri-operative outcomes of the procedure. More recent publications have focused on the long-term outcomes of the procedure, as well as on immunosuppression and rejection.

The total citations of the 100 most cited papers in our analysis ranged from 21 to 305, a number considerably lower than citation numbers seen in other fields such as transplantation (576–3078) [7], liver cancer (612–5358)

[117], orthopedic surgery (757–3860) [8], and hand surgery (88–455). [13]

The lower number may reflect the youth of the field, as well as the number of

researchers focusing on face transplantation [117], as face transplantation is a niche field with a relatively small number of researchers focusing on the subject.

Although it is commonly believed that older publications accrue more citations, owing to the time factor, in this analysis, we identified an inverted U pattern, with most publications in the top 100 being published between

Table 3 Number of papers per journal

Rank	Journal	Number of papers	Impact factor
1	<i>Plastic and Reconstructive Surgery</i>	27	4.73
2	<i>American Journal of Transplantation</i>	11	8.09
3	<i>Journal of Plastic Reconstructive And Aesthetic Surgery</i>	8	2.74
4	<i>Lancet</i>	6	79.32
=5	<i>Annals of Plastic Surgery</i>	5	1.54
=5	<i>Current Opinion in Organ Transplantation</i>	5	2.64
=5	<i>Transplantation</i>	5	4.94
=8	<i>American Journal of Bioethics</i>	4	11.23
=8	<i>Journal of Craniofacial Surgery</i>	4	1.05
=10	<i>Journal of Reconstructive Microsurgery</i>	3	2.87
=10	<i>New England Journal of Medicine</i>	3	91.25
=10	<i>Psychosomatics</i>	3	2.39
=10	<i>Transplant International</i>	3	3.78
=14	<i>Acta Chirurgica Belgica</i>	1	1.09
=14	<i>American Journal of Neuroradiology</i>	1	3.83
=14	<i>Annals of Surgery</i>	1	12.97
=14	<i>Burns</i>	1	2.74
=14	<i>Clinics in Plastic Surgery</i>	1	2.02
=14	<i>Current Opinion in Otolaryngology & Head and Neck Surgery</i>	1	2.06
=14	<i>International Journal of Surgery</i>	1	6.07
=14	<i>Journal of Materials Science-Materials in Medicine</i>	1	3.90
=14	<i>Journal of Oral and Maxillofacial Surgery</i>	1	1.90
=14	<i>Medical Science Monitor</i>	1	2.65
=14	<i>Medicina Oral, Patologia Oral, Cirugia Bucal</i>	1	2.05
=14	<i>Microsurgery</i>	1	2.43
=14	<i>Transplantation Proceedings</i>	1	1.07

2010 and 2013, and the top 10 all published after 2007. This is in agreement with a bibliometric analysis of the most cited articles in surgery [6]. Vázquez et al. performed a bibliometric analysis of the top 100 most cited articles in the five surgery journals with the highest impact factor and identified that 20% of these papers were published after 2000.

They hypothesize this phenomenon to be due to “obliteration by incorporation,” that is, once scientific ideas and hypotheses become generally proven and accepted, the articles which originally proposed these ideas are no longer cited. [6, 7, 17, 118–121]

It has also been argued that the number of citations an article accrues is dependent on the IF of the journal in which it was published [120, 122]. This is a pattern we identified in our bibliometric analysis, as we identified a significant positive correlation between IF and total citations.

As described by O’Sullivan and Hurley in their bibliometric analysis of publications in the field

of transplantation [7], the field is unique within the practice of medicine and surgery, as it required extensive and revolutionary in vitro and in vivo technical, procedural, immunological, and tissue-specific research to achieve the landmark steps seen in clinical practice. In just two decades, we have witnessed the field of face transplantation progress from a written hypothesis to a worldwide clinical occurrence.

Reflective of the youth of the field is also the fairer distribution of citations in terms of author gender, with Dr. Maria Siemionow being the corresponding author with the greatest number of citations. In addition, 33% of the most cited corresponding authors were female. In contrast, a recent cross-sectional study analyzing more than 5000 articles published in high-impact medical journals identified that work published by women first or corresponding authors had fewer citations than those written by men first or corresponding authors [123]. This is not seen in our bibliometric analysis and may be a hopeful reflection of the future of academia.

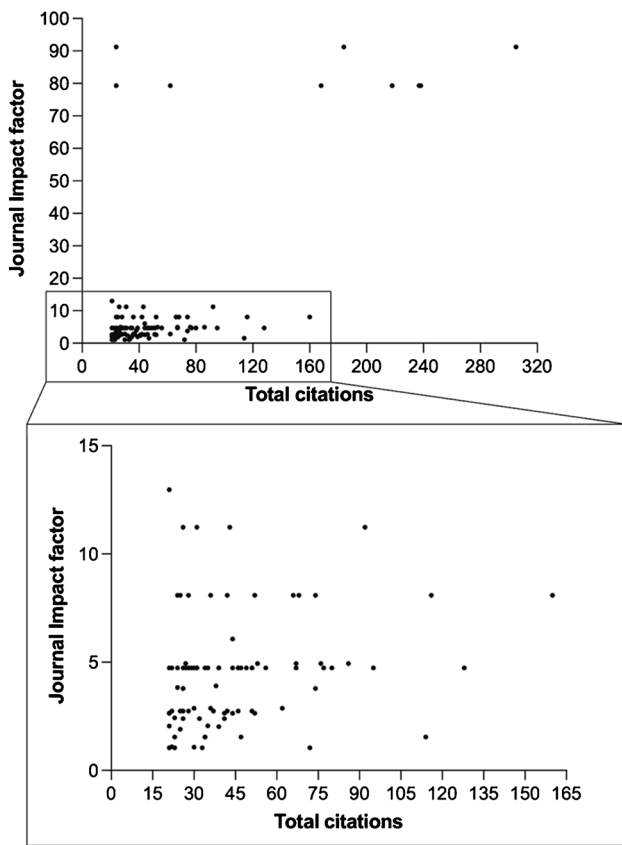


Fig. 5 Correlation between journal impact factor and total citations. Impact factor positively correlated with total citations ($R^2=0.4525$, $p < 0.0001$)

It is important to note that the list of the top 100 most cited manuscripts will undoubtedly change in the future, as multiple multicenter collaborations, studies known to have strong citation potential [10], are now underway or have

been recently published [124, 125]. Ongoing advancements in the field, including re-transplantation procedures [126, 127], and modifications in monitoring and immunosuppression recommendations [128] will also impact the list of the 100 most cited. As such, bibliometric analyses of fast-paced medical fields, such as that of face transplantation, require regular 5- to 10-year updates to reflect the ongoing evolution. [10]

Limitations

This bibliometric analysis is associated with limitations inherent to bibliometric analyses. One such limitation is “incomplete citing,” whereby publications are cited to persuade the reader rather than to credit the most influential work [13]. Although we did not have set exclusions based on language, language bias toward the English language does exist in academia [129]. Other biases include journal bias, influential person, state or institution, bias, in-house bias, and self-citation bias [13]. Omission bias, whereby researchers purposely avoid citing competitors, has also been noted [130]. Furthermore, for this bibliometric analysis, we opted to exclude studies which did not focus primarily on face transplantation, choosing to exclude studies which also discussed limb transplantation resulting in selection bias. A further limitation in our methodology was that we chose to focus only on the first and corresponding authors, but authors in the top 100 did contribute to multiple other publications, and their overall contribution to the field is as such underestimated [13]. Despite these biases, the top 100 most-cited papers which we identified in this bibliometric analysis are a great representation of some of the most influential work over the past two decades.

Table 4 Institutions with more than one paper in the top 100. Institution as listed for corresponding author

Rank	Institution	Number of papers
1	Department of Plastic Surgery, Cleveland Clinic	22
2	Division of Plastic Surgery, Department of Surgery, Brigham and Women's Hospital	20
3	Department of Plastic and Reconstructive Surgery, Henri Mondor Hospital	6
=4	Department of Plastic Surgery, NYU Langone Medical Center	5
=4	Department of Surgery, University of Louisville	5
=6	Department of Plastic and Reconstructive Surgery, Royal Free Hospital London	4
=6	Department of Transplantation, Edouard Herriot Hospital	4
=8	Department of Plastic and Reconstructive Surgery, University Hospital Gent	3
=8	Department of Psychiatry and Psychology, Cleveland Clinic	3
=10	Department of Psychiatry, Brigham and Women's Hospital	2
=10	Institute of Plastic Surgery, Xijing Hospital	2

Table 5 Corresponding authors with more than one paper in the top 100

Author	Number of papers in top 100	Number of papers in top 50	Number of papers in top 10
Maria Siemionow	18	13	2
Bohdan Pomahac	16	7	2
Chad R. Gordon	5	3	1
John H. Barker	5	3	0
Eduardo D. Rodriguez	5	3	1
Peter E. M. Butler	4	2	0
Kathy L. Coffman	3	2	0
Nathalie A. Roche	3	1	0
Laurent Lantieri	3	2	2
Palmina Petruzzo	2	2	0
François Petit	2	1	0
Jean-Michel Dubernard	2	1	1

Conclusions

This bibliometric analysis identifies the most influential papers, in terms of citation power, in the field of face transplantation. The evolution of the publications in this list broadly represents the landmark developments in the field of face transplantation. The bibliometric analysis helps researchers identify the authors and institutions who have led innovation in face transplantation and comprehend the rapid rate of progression of the field. Lastly, our data summarizes important information on what establishes a publication as influential.

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Data availability All datasets are available from the corresponding author upon reasonable request.

Declarations

Ethics approval This article does not contain any studies involving human participants or animals performed by any of the authors. This is a review study and no ethical approval is required.

Consent to participate Not required.

Conflict of interest Adriana C. Panayi, Samuel Knoedler, Martin Kauke-Navarro, Valentin Haug, Doha Obed, and Bohdan Pomahac declare no conflict of interest.

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