

# Plastic Surgery and the Breast: A Citation Analysis of the Literature

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**Background:** A large proportion of the plastic surgery literature is dedicated to the breast. It is one of the most common topics in our specialty, yet it is unclear which articles have been the most influential. The purpose of this study was to identify the top 100 most-cited articles on breast in the plastic surgery literature and examine the characteristics of each individual article.

**Methods:** Using an electronic database through the Web of Science, we were able to determine the 6 journals that contributed to the 100 most-cited articles on breast in the plastic surgery literature.

**Results:** Each article was examined individually looking at characteristics such as subject matter, article type, country of origin, institution, authorship, and year of publication. *Plastic and Reconstructive Surgery* contributed the most articles to the top 100 with 81 articles including the most-cited article which has been referenced 673 times to date. The United States produced 73% of the top 100 articles, and the most prolific institution was the University of Texas M. D. Anderson Cancer Center with 15 articles.

**Conclusions:** This study has identified the most influential articles on breast in the plastic surgery literature over the past 68 years and highlighted many important scientific breakthroughs and landmarks that have occurred during this time. (*Plast Reconstr Surg Glob Open* 2014;2:e251; doi: 10.1097/GOX.0000000000000202; Published online 12 November 2014.)

A significant proportion of the plastic surgery literature is dedicated to breast surgery ranging from complex microsurgical reconstruction to aesthetic augmentation. It is one of the most commonly published topics in plastic and reconstructive surgery with a plethora of diverse articles

written by a myriad of illustrious authors. Despite this considerable archive of published material, it remains nebulous as to which precise articles have influenced our specialty most.

The citation number of an article is one method of gauging the impact that piece of work has made on a specific area.<sup>1</sup> A citation is an alphanumeric expression that is an acknowledgment of the relevant published work by other authors. Its objective is to recognize other authors for their relevant published articles, and the citation number is increasingly used in determining how grants, subsidies, and awards are appointed.<sup>1-3</sup>

Compared to more recent articles, older articles have a greater likelihood of gaining a higher citation number due to a longer duration in print. The citation index, described by Loonen et al,<sup>4</sup> was devised to counter this potential bias. It is defined as the

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Received for publication June 27, 2014; accepted August 25, 2014.

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DOI: 10.1097/GOX.0000000000000202

**Disclosure:** The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.

mean number of times an article has been cited up to 16 years post publication. The article by Loonen et al<sup>4</sup> established that the most compelling change in annual increase of the fraction of citations materialized 16 years after publication, so this was accepted as the critical citable period.

The citation rate of a scientific journal is commonly referred to as the impact factor (IF), and it is used as a proxy for the relative importance of an academic journal within its field.<sup>5</sup> It is calculated on an annual basis in Science Citation Index Journal Citation Reports, and it is widely regarded as a quality ranking for journals and abundantly used by the leading journals in their advertising.<sup>5-7</sup> Despite the reported flaws with this system, it still remains the best available tool for judging the merits of specific journals. It is calculated by dividing the number of current year citations to the source items published in that journal during the preceding 2 years. In some countries, journal IFs are also used in the evaluation of individuals for academic positions, and they are even used as one of the premises for allocation of university resources.<sup>8</sup> The growing perception of IFs and their potential usage for evaluation purposes have already altered the publishing behavior of authors as they seek to publish in journals with maximum impact. This can negatively impact on specialist journals that may be more appropriate targets for their publications.<sup>2</sup>

Bibliometrics is a set of methods to quantitatively analyze academic literature, and citation analysis is the most commonly used technique. The purpose of this study was to perform a citation analysis on the most-referenced breast articles in the plastic surgery literature and analyze each article individually looking at its citation index, article type, authorship, country of origin, institution, level of evidence, and publication year.

## MATERIALS AND METHODS

The 11 leading plastic surgery journals with the highest IF were included in our analysis (Table 1). The Web of Science, which is produced by the Institute of Scientific Information, provides Web access to the Science Citation Index, MEDLINE, and other citation indexes, which collectively index more than 12,000 journals worldwide. Through this online database, we were able to identify the most-cited breast articles in our chosen journals. All indexed articles from these 11 publications were combined and ranked according to their citation number. Two of the authors (C.W.J., K.M.J.) independently searched these results to identify the 100 most-cited articles

**Table 1. The Journals and the Number of Articles Each Journal Contributed to the Top 100 Articles**

Journal	No. Articles in Top 100
<i>Plastic and Reconstructive Surgery</i>	81
<i>Annals of Plastic Surgery</i>	7
<i>British Journal of Plastic Surgery</i>	6
<i>Aesthetic Plastic Surgery</i>	3
<i>Journal of Plastic Reconstructive and Aesthetic Surgery</i>	2
<i>Scandinavian Journal of Plastic and Reconstructive Surgery</i>	1

These journals were included in our citation search but did not contribute to the top 50: *Aesthetic Surgery Journal*, *Canadian Journal of Plastic Surgery*, *Clinics in Plastic Surgery*, *European Journal of Plastic Surgery*, and *Journal of Plastic Surgery and Hand Surgery*.

pertaining to breast surgery, and there was 100% concordance between them.

One of the authors (C.W.J.) analyzed each article individually to identify the topic of interest, authorship, article type, country of origin, institution, level of evidence, and year of publication. The citation index was calculated to limit the potential bias favoring older articles.<sup>1,4</sup> This was calculated by finding the mean number of times each article was cited up to 16 years post publication. For articles that were published within the past 16 years, the total citation numbers since publication were divided by the number of years since publication.

## RESULTS

Table 2 lists the most-cited breast articles in the plastic surgery literature in descending order of citations. These citations ranged from 96 to 673, with a mean of  $151.87 \pm 74.09$ . Eleven plastic surgery journals were included in the original search, yet contributions to the top 100 only came from six of these. *Plastic and Reconstructive Surgery* produced 81 of the most-cited articles while the *Annals of Plastic Surgery* had 7 articles in our most-cited list.

The article that received the most citations was written by Hartrampf et al<sup>9</sup> in 1982 and published in *Plastic and Reconstructive Surgery*. The oldest article by Ribeiro<sup>10</sup> was published in 1975, with 118 citations, whereas the most recent article by Chun et al<sup>11</sup> was published in 2010 and has been cited 97 times to date. The 1990s and 2000s dominated the top 100 list with 38 articles and 35 articles, respectively (Table 3).

The citation index ranged from 1.9 to 31, and the mean citation index was  $10.84 \pm 6.21$ . The article with the highest citation index was by Allen and Treece<sup>12</sup> from 1984. This was published in the *Annals of Plastic Surgery* and was ranked second in the top 100 most-cited list with 454 citations. The mean citation index for the top 25 most-cited articles was  $15.772 \pm 8.05$ ,

**Table 2. The Top 100 Most-cited Articles Relating to the Breast in the Plastic Surgery Literature Along with Their Citation Index**

Rank	Author	Citations	CI
1	Hartrampf et al <sup>9</sup>	673	16.3
2	Allen and Treece <sup>12</sup>	454	31
3	Radovan <sup>13</sup>	371	16.4
4	Khoury et al <sup>33</sup>	279	24.7
5	Blondeel <sup>14</sup>	248	23.3
6	Holmström <sup>34</sup>	216	3.3
7	Gill et al <sup>35</sup>	210	21
8	McKissock <sup>36</sup>	207	5.2
9	Lejour <sup>37</sup>	203	10.7
10	Lejour <sup>15</sup>	203	21.1
11	Nahabedian et al <sup>38</sup>	202	16.8
12	Coleman <sup>16</sup>	198	24.8
13	Bostwick et al <sup>39</sup>	192	7.6
14	Grotting et al <sup>40</sup>	190	9.8
15	Toth and Lappert <sup>41</sup>	184	14.1
16	Yoshimura et al <sup>42</sup>	184	30.7
17	Kroll et al <sup>43</sup>	181	22.6
18	Slavin et al <sup>44</sup>	178	11.1
19	Spear and Onyewu <sup>45</sup>	177	12.6
20	Alderman et al <sup>46</sup>	173	14.4
21	Allen and Tucker <sup>17</sup>	171	11.8
22	Kroll <sup>47</sup>	168	12
23	Coleman and Saboeiro <sup>48</sup>	167	23.8
24	Stevens et al <sup>49</sup>	165	6.1
25	Robbins <sup>50</sup>	164	3.1
26	Blondeel et al <sup>51</sup>	162	10.1
27	Kroll et al <sup>52</sup>	160	10.7
28	Benelli <sup>18</sup>	160	9
29	Courtiss and Goldwyn <sup>53</sup>	159	3.7
30	Kroll et al <sup>54</sup>	157	10
31	Tran et al <sup>55</sup>	156	12
32	Man et al <sup>56</sup>	156	12
33	Kroll and Baldwin <sup>57</sup>	154	9.3
34	Masia et al <sup>58</sup>	153	19.1
35	Alderman et al <sup>59</sup>	153	10.9
36	Rudolph et al <sup>60</sup>	152	6.1
37	Blondeel et al <sup>61</sup>	149	9.3
38	Blondeel and Boeckx <sup>62</sup>	146	9.8
39	Blondeel et al <sup>63</sup>	146	10.4
40	Deapen et al <sup>64</sup>	146	7.6
41	Hall-Findlay <sup>65</sup>	144	9.6
42	Chang et al <sup>66</sup>	141	10.1
43	Wilkins et al <sup>67</sup>	140	10
44	Weisman et al <sup>19</sup>	140	7.7
45	Disa et al <sup>20</sup>	139	9.3
46	Hidalgo et al <sup>68</sup>	137	8.6
47	Handel et al <sup>69</sup>	137	10.3
48	Cordeiro et al <sup>70</sup>	134	13.4
49	Hamdi et al <sup>71</sup>	134	8.9
50	Breuing and Warren <sup>21</sup>	133	14.7
51	Watterson et al <sup>72</sup>	133	10.1
52	Schusterman et al <sup>73</sup>	133	9.7
53	Barker et al <sup>74</sup>	133	4.2
54	Evans et al <sup>75</sup>	132	10.3
55	Kroll et al <sup>76</sup>	131	10.5
56	Heggens et al <sup>77</sup>	130	6.3
57	Giunta et al <sup>78</sup>	127	9.1
58	Futter et al <sup>79</sup>	126	9
59	Chang et al <sup>80</sup>	126	9
60	Spear et al <sup>81</sup>	126	21
61	Schneider et al <sup>82</sup>	126	3.3
62	Arnold and Pairoloero <sup>83</sup>	125	12.6
63	Kroll and Netscher <sup>84</sup>	125	6.3
64	Shaw <sup>85</sup>	125	4.5

(Continued)

**Table 2. Continued**

Rank	Author	Citations	CI
65	McGrath and Burkhardt <sup>86</sup>	124	7.6
66	Courtiss and Goldwyn <sup>87</sup>	124	2.6
67	Pusic et al <sup>22</sup>	123	24.6
68	Delay et al <sup>88</sup>	122	7.6
69	Wellisch et al <sup>89</sup>	122	4.3
70	Handel et al <sup>90</sup>	122	15.2
71	Elliott et al <sup>91</sup>	122	7.6
72	Courtiss et al <sup>92</sup>	120	3.8
73	Domanskis and Owsley <sup>93</sup>	118	4.1
74	Ribeiro <sup>10</sup>	118	1.9
75	Lejour and Dome <sup>94</sup>	117	6.1
76	de Camara et al <sup>95</sup>	114	8.3
77	Schusterman et al <sup>96</sup>	113	9.9
78	Kroll and Marchi <sup>97</sup>	113	6.8
79	Nahabedian et al <sup>98</sup>	113	12.6
80	Geddes et al <sup>99</sup>	110	10
81	Tran et al <sup>100</sup>	109	7.8
82	Spear and Baker <sup>23</sup>	108	6.1
83	Thomsen et al <sup>101</sup>	108	6.2
84	Zienowicz and Karacaoglu <sup>102</sup>	107	15.2
85	Wei and Mardini <sup>103</sup>	107	10.7
86	Blondeel et al <sup>104</sup>	106	9.6
87	Asplund <sup>105</sup>	106	4.9
88	Tebbetts <sup>24</sup>	103	7.9
89	Salzberg <sup>106</sup>	102	12.8
90	Pajkos et al <sup>107</sup>	101	9.2
91	Spear and Majidian <sup>108</sup>	101	6.3
92	Schnur et al <sup>109</sup>	101	5.9
93	Gonzalez et al <sup>110</sup>	100	6
94	Marchac and de Olarte <sup>111</sup>	100	2.9
95	Alonso-Burgos et al <sup>112</sup>	99	12.3
96	Nahabedian <sup>113</sup>	99	8.3
97	Bircoll <sup>114</sup>	99	2
98	Breuing <sup>115</sup>	98	14
99	Chun <sup>11</sup>	97	24.3
100	Williams <sup>25</sup>	96	5.7

CI, citation index.

whereas for the 75th to 100th most-cited articles, it was  $9.03 \pm 4.59$ . We also ranked the top 100 most-cited articles in terms of citation index (Table 4), and we found that more recent articles tended to have a higher citation index compared with older articles. The mean year of publication for the 25 articles with the highest citation index was  $2001 \pm 7.7$  years, whereas it was  $1984 \pm 7.8$  for the 25 articles with the lowest citation index.

To facilitate the analysis of the characteristics of each article, the 100 articles were placed into 7 categories—free tissue transfer, implant/expander, pedicled transverse rectus abdominis myocutaneous (TRAM), reduction mammoplasty, fat transfer, latissimus dorsi, and miscellaneous breast (Table 5). If an article dealt with 2 of the categories of interest, it would be added to both of these categories. The most common topic was free tissue transfer, and this accounted for 37 articles in total. Of these, 26 focused on the free TRAM or deep inferior epigastric artery perforator (DIEAP) flap, whereas 9 articles were based on general aspects of free tissue

**Table 3. The Decades with the Top 100 Most-cited Articles**

Decade	No. Articles
1990s	38
2000–2009	35
1980s	14
1970s	12
2010–2013	1

transfer for breast reconstruction. The remaining 2 articles described the superior gluteal artery perforator flap. The pedicled TRAM flap was the subject of 13 articles, and 7 of these articles compared free and pedicled TRAM flaps in terms of outcomes and donor-site morbidity. Breast implants and expanders were the focus of 27 articles of which seven outlined the use of acellular dermal matrix as an adjunct to breast augmentation. Four articles focused on capsular contracture, whereas 3 articles looked at the effects on irradiation post breast augmentation. Reduction mammoplasty was the basis for 10 articles and four of these described the vertical mammoplasty. The inferior pedicle technique was the subject

**Table 4. The 100 Most-cited Articles and Their Year of Publication Ranked According to Their Citation Index**

Rank	Author	CI	Year
1	Allen and Treece <sup>12</sup>	31	1994
2	Yoshimura et al <sup>42</sup>	30.7	2007
3	Coleman <sup>16</sup>	24.8	2006
4	Khoury et al <sup>33</sup>	24.7	1998
5	Pusic et al <sup>22</sup>	24.6	2009
6	Chun <sup>11</sup>	24.3	2010
7	Coleman and Saboeiro <sup>48</sup>	23.8	2007
8	Blondeel <sup>14</sup>	23.3	1999
9	Kroll et al <sup>43</sup>	22.6	1996
10	Lejour <sup>15</sup>	21.1	1994
11	Spear et al <sup>81</sup>	21	2008
12	Gill et al <sup>35</sup>	21	2004
13	Masia et al <sup>58</sup>	19.1	2006
14	Nahabedian et al <sup>38</sup>	16.8	2002
15	Radovan <sup>13</sup>	16.4	1982
16	Hartrampf et al <sup>9</sup>	16.3	1982
17	Handel et al <sup>69</sup>	15.2	2006
18	Zienowicz and Karacaoglu <sup>102</sup>	15.2	2007
19	Breuing and Warren <sup>21</sup>	14.7	2005
20	Alderman et al <sup>46</sup>	14.4	2002
21	Toth and Lappert <sup>41</sup>	14.1	1991
22	Breuing <sup>115</sup>	14	2007
23	Cordeiro et al <sup>70</sup>	13.4	2004
24	Salzberg <sup>106</sup>	12.8	2006
25	Spear and Onyewu <sup>45</sup>	12.6	2000
26	Arnold and Pairolero <sup>83</sup>	12.6	1996
27	Nahabedian et al <sup>98</sup>	12.6	2005
28	Alonso-Burgos et al <sup>112</sup>	12.3	2006
29	Tran et al <sup>55</sup>	12	2001
30	Kroll <sup>47</sup>	12	2000
31	Man et al <sup>56</sup>	12	2001
32	Allen and Tucker <sup>17</sup>	11.8	1995
33	Slavin et al <sup>44</sup>	11.1	1998
34	Alderman et al <sup>59</sup>	10.9	2000

(Continued)

**Table 4. Continued**

Rank	Author	CI	Year
35	Lejour <sup>37</sup>	10.7	1999
36	Kroll et al <sup>52</sup>	10.7	1999
37	Wei and Mardini <sup>103</sup>	10.7	2004
38	Kroll et al <sup>76</sup>	10.5	1995
39	Blondeel et al <sup>63</sup>	10.4	2000
40	Handel et al <sup>69</sup>	10.3	1995
41	Evans et al <sup>75</sup>	10.3	1995
42	Blondeel et al <sup>51</sup>	10.1	1998
43	Chang et al <sup>66</sup>	10.1	2000
44	Watterson et al <sup>72</sup>	10.1	1995
45	Geddes et al <sup>99</sup>	10	2003
46	Wilkins et al <sup>67</sup>	10	2000
47	Kroll et al <sup>54</sup>	10	1996
48	Schusterman et al <sup>96</sup>	9.9	1992
49	Grotting et al <sup>40</sup>	9.8	1989
50	Blondeel and Boeckx <sup>62</sup>	9.8	1994
51	Schusterman et al <sup>73</sup>	9.7	1994
52	Hall-Findlay <sup>65</sup>	9.6	1999
53	Blondeel et al <sup>104</sup>	9.6	2003
54	Blondeel et al <sup>61</sup>	9.3	1997
55	Disa et al <sup>20</sup>	9.3	1999
56	Kroll and Baldwin <sup>57</sup>	9.3	1992
57	Pajkos et al <sup>107</sup>	9.2	2003
58	Giunta et al <sup>78</sup>	9.1	2000
59	Benelli <sup>18</sup>	9	1990
60	Chang et al <sup>80</sup>	9	2000
61	Futter et al <sup>79</sup>	9	2000
62	Hamdi et al <sup>71</sup>	8.9	1999
63	Hidalgo et al <sup>68</sup>	8.6	1998
64	de Camara et al <sup>95</sup>	8.3	1993
65	Nahabedian <sup>113</sup>	8.3	2002
66	Tebbetts <sup>24</sup>	7.9	2001
67	Tran et al <sup>100</sup>	7.8	2000
68	Weisman et al <sup>19</sup>	7.7	1988
69	Bostwick et al <sup>39</sup>	7.6	1978
70	Deapen et al <sup>64</sup>	7.6	1986
71	Delay et al <sup>88</sup>	7.6	1998
72	Elliott et al <sup>91</sup>	7.6	1993
73	McGrath and Burkhardt <sup>86</sup>	7.6	1984
74	Kroll and Marchi <sup>97</sup>	6.8	1992
75	Heggens et al <sup>77</sup>	6.3	1983
76	Kroll and Netscher <sup>84</sup>	6.3	1983
77	Spear and Majidian <sup>108</sup>	6.3	1998
78	Thomsen et al <sup>101</sup>	6.2	1990
79	Lejour and Dome <sup>94</sup>	6.1	1991
80	Rudolph et al <sup>60</sup>	6.1	1978
81	Spear and Baker <sup>23</sup>	6.1	1995
82	Stevens et al <sup>49</sup>	6.1	1984
83	Gonzalez et al <sup>110</sup>	6	1993
84	Schnur et al <sup>109</sup>	5.9	1997
85	Williams et al <sup>25</sup>	5.7	1997
86	McKissock <sup>36</sup>	5.2	1972
87	Asplund <sup>105</sup>	4.9	1984
88	Shaw <sup>85</sup>	4.5	1983
89	Wellisch et al <sup>89</sup>	4.3	1985
90	Barker et al <sup>74</sup>	4.2	1978
91	Domanskis and Owsley <sup>93</sup>	4.1	1976
92	Courtiss et al <sup>92</sup>	3.8	1979
93	Courtiss and Goldwyn <sup>53</sup>	3.7	1977
94	Holmström <sup>34</sup>	3.3	1979
95	Schneider et al <sup>82</sup>	3.3	1977
96	Robbins <sup>50</sup>	3.1	1977
97	Marchac and de Olarte <sup>111</sup>	2.9	1982
98	Courtiss and Goldwyn <sup>87</sup>	2.6	1976
99	Bircoll <sup>114</sup>	2	1987
100	Ribeiro <sup>10</sup>	1.9	1975

CI, citation index.

**Table 5. The Number of Articles in Each Subcategory**

Subject	No. Articles
Free tissue transfer	37
Implant/expander reconstruction	27
TRAM reconstruction	13
Miscellaneous breast	13
Reduction mammoplasty	10
Fat transfer	4
Latissimus dorsi reconstruction	3

of 2 articles. Four articles looked at free fat transfer to the breast, and 3 articles described the latissimus dorsi reconstruction. Thirteen articles were placed in the miscellaneous breast category, and these included 2 articles on the results of the Michigan Breast Outcome Study and an article describing the Breast Q. The miscellaneous category also included an article that described the importance of plastic surgery input for mastectomy skin incisions and an article comparing breast sensation before and after reconstruction.

Eighty-eight of the articles were clinical, five were experimental, and seven were review articles. The majority of articles were level 3 or 4 evidence, and this can be seen in Table 6.

Thirteen countries produced all of the 100 articles, with 73% originating from the United States (Table 7) and 9% from Belgium. The University of Texas M. D. Anderson Center was the institution that contributed the most to the top 100 articles with 15 articles (Table 8). The University of California System published 8 articles while University Hospital Gent, Belgium, contributed 6 articles to the top 100 list.

Forty-four authors contributed more than one article each to the top 100 list, and 12 of these were first-named authors on 2 or more articles. Doctors Kroll, Blondeel, Spear, Courtiss, and Lejour were all first-named authors on 3 or more articles.

The most-cited article on our list was by Hartrampf et al<sup>9</sup> from 1982 in which they described the TRAM flap for the first time. At number two, with 454 citations, was the article by Allen and Treece<sup>12</sup>

**Table 6. The Study Type and Levels of Evidence of the 100 Most-cited Articles**

Clinical Study Type	No. Studies
Therapeutic	82
Level 2	5
Level 3	23
Level 4	51
Level 5	3
Diagnostic	4
Level 2	1
Level 3	3
Prognostic	2
Level 2	1
Level 4	1

**Table 7. The Countries of Origin of the 100 Most-cited Articles**

Nation	No. Articles
United States	73
Belgium	9
France	3
United Kingdom	3
Australia	2
Canada	2
Spain	2
Brazil	1
Denmark	1
Germany	1
Japan	1
Sweden	1
Taiwan	1

from 1994, which was one of the first reports on the DIEAP flap for breast reconstruction.

The third most-cited article was by Radovan<sup>13</sup> in which he described the use of the tissue expander post mastectomy, and this article has been referenced 371 times to date. At number five, Blondeel<sup>14</sup> described his own experience of performing 100 DIEAP flaps, whereas at number 10, Lejour<sup>15</sup> detailed the vertical reduction mammoplasty. In 12th place with 198 citations, Coleman<sup>16</sup> discussed the role of fat grafting for soft-tissue augmentation. The superior gluteal artery perforator flap was described by Allen and Tucker,<sup>17</sup> and this was the 21st most-referenced article with 171 citations. At 28, the “round block” technique for mammoplasty was outlined by Benelli<sup>18</sup> in *Aesthetic Plastic Surgery* in 1990 and has received 160 citations. At 44, Weisman et al<sup>19</sup> examined the link between connective tissue diseases following breast augmentation, and this was followed at 45 by the 1999 article by Disa et al<sup>20</sup> that assessed the efficacy of free flap monitoring. The 50th most-cited article

**Table 8. The Institutions That Contributed the Most Articles to the 100 Most-cited Articles on Breast in the Plastic Surgery Literature**

Institution	No. Articles
University of Texas M. D. Anderson Cancer Center, Houston, Tex.	15
University of California System, Calif.	8
University Hospital, Gent, Belgium	6
Georgetown University Medical Center, Washington, D.C.	4
Harvard Medical School, Boston, Mass.	4
Memorial Sloan-Kettering Cancer Center, New York, N.Y.	4
Cape Cod Hospital, Hyannis, Mass.	3
Johns Hopkins Medical Institutions, Baltimore, Md.	3
Institut Médical Edith Cavell, Brussels, Belgium	3
Louisiana State University Medical Center, New Orleans, La.	3
The University of Michigan Medical Center, Mich.	3

was by Breuing and Warren,<sup>21</sup> and it described immediate bilateral breast reconstruction using implants in conjunction with an acellular dermal matrix. In 67th place, Pusic et al<sup>22</sup> outlined the development of the BREAST-Q, and this has been cited 123 times to date. The classification of capsular contracture following breast augmentation was proposed by Spear and Baker<sup>23</sup> at 82, whereas the “Gent” consensus on perforator flap terminology was the 86th most-cited article. At 88, the dual plane breast augmentation was first described by Tebbetts<sup>24</sup> in 2001. The last article in the 100 most-cited articles was the 1997 article by Williams et al.<sup>25</sup> It described the effects of radiation after TRAM breast reconstruction and was cited 96 times.

## DISCUSSION

A large proportion of the plastic surgery literature is dedicated to the breast, and it ranges from implant-based augmentation to complex microvascular free tissue transfer. The list of 100 most-cited articles reflects the evolution of breast reconstruction and contains numerous first descriptions of groundbreaking procedures, authored by many well-regarded names in plastic surgery. However, many seminal articles on breast surgery failed to make it into the top 100, and this may, in part, be explained by the phenomenon of “obliteration by incorporation” whereby many “classics” have become such “common knowledge” over time so that they fail to attain more citations. Examples include the articles by Hayes et al<sup>26</sup> and Cronin et al.<sup>27</sup> Both of these articles would be well known to most plastic surgeons, yet neither received enough citations to be included in the top 100 list.

Several limitations exist with a study of this nature. “Incomplete citing” is an occurrence that arises when citations are made with the aim of reader persuasion rather than acknowledgment of influential works. Other biases that exist include self-citation, journal bias, in-house bias, and omission bias by intentionally failing to cite competitors.<sup>6</sup> For this study, we chose to examine breast surgery articles in the most well-regarded plastic surgery journals only.

A limitation of this study would be that we did not include any plastic surgery breast articles that were in other specialty journals, as it would be virtually impossible to identify all of them. A good example of a well-referenced breast plastic surgery article that was published in a non-plastic surgery journal is the 1994 article by Gabriel et al.<sup>28</sup> This *New England Journal of Medicine* article describes the risk of connective tissue disease post breast implantation and has been cited 351 times to date.

It has been reported by some authors that the most important articles can actually be found in

the reference list of the most-cited articles.<sup>1,29</sup> However, it has also been noted that older articles tend to receive more citations because of a longer citable period than more recent articles.<sup>1</sup> To counteract this perceived bias, we used the citation index and we actually found this to be higher for more recently published articles than older articles. The explanation for this is likely 2-fold. First, the growing popularity of citation managers (ie, EndNote, Thomson Reuters, N.Y.) facilitates an almost effortless incorporation of large numbers of citations in today’s articles that would not have been possible previously. Second, the online availability of recent articles makes accessing them very easy, whereas far fewer older articles tend to be available online and their retrieval typically necessitates a good deal of effort from library holdings, etc.

Most studies were level 3 or 4 evidence, and this would indicate that no positive correlation exists in plastic surgery breast articles, between a high citation number and a high level of evidence. This is very similar to the findings of Loonen et al<sup>4</sup> in their analysis of the most-cited articles in plastic surgery. This may be explained by the fact that there are very few higher levels of evidence in plastic surgery breast articles or that the higher levels of evidence are just not frequently cited. It is likely, however, that plastic surgery as a specialty does not lend itself to randomized controlled trials compared to medicine, and this is why the majority of published articles are either level 4 or 5 evidence.<sup>30</sup> Limited disease incidence, the difficulty in standardizing a surgical treatment, and the varying experience and expertise of different surgeons often make surgery less suitable for clinical trials than medicine.<sup>31,32</sup> It is not surprising that there are few level 1 and 2 evidence articles in the plastic surgery breast literature as the majority of systematic reviews, meta-analyses, and randomized controlled trials focus on the outcome of a certain intervention on a specific condition. Aesthetic outcomes following reconstruction or augmentation tend to be the main focus of plastic surgery breast articles rather than pathologic disease, and consequently, articles with lower evidence levels are relatively more valuable in plastic surgery than many other specialties.

Review articles tend to receive a greater number of citations than other published articles, yet only 7 review articles were found in the top 100 list.<sup>2</sup> This may indicate that basic research articles incorporating novel techniques and innovations are of preferred interest to plastic surgery breast authors.

The top 100 list contains many landmark articles that were the first description of a new technique or procedure and as a result have been cited plentifully by subsequent authors. The first 3 articles on the

most-cited list are prime examples of this as they are early descriptions of the TRAM flap, the deep inferior epigastric perforator flap, and tissue expansion of the breast.<sup>9,12,13</sup> These articles were definite “game-changers” in breast reconstruction, and it is no surprise that they are the most heavily referenced articles. Breast reconstruction procedures have evolved over the past 40 years, and the top 100 list is reflective of these changes. The mean year of publication was  $2000 \pm 3.8$  for articles on DIEP flap reconstruction,  $1993 \pm 5.3$  for pedicled TRAM flaps,  $1990 \pm 9.5$  for silicone breast implants, and  $2007 \pm 1.7$  for articles on acellular dermal matrix, and these seem to echo the trends seen in surgical practice over the years.

### CONCLUSIONS

Although certain intrinsic limitations exist with a citation analysis, it does provide an objective and quantitative measure of the impact that an article has on its respective field. The top 100 most cited papers certainly highlight many of the seminal papers relating to breast but does not provide information about the quality of the research or the influence on clinical practice. It does, however, provide useful information on readership, and many of these articles are seminal papers whose importance is reflected in the number of citations from peers that they have received.

The majority of articles listed in the top 100 have been hugely influential on our specialty despite several seminal articles being omitted due to low citation numbers. Many of the articles describe pioneering procedures that are commonplace today. The citation index was devised to overcome the reported bias associated with older articles in bibliometric studies, yet it is far from ideal system.<sup>14</sup> We found that the citation index favors more recent articles over older ones, yet this is not at all surprising as older articles tend to be cited at a less frequent rate. Despite the documented flaws with using citation numbers in assessing the influence of published material, we feel it remains a superior method than citation index in gauging which articles have had the greatest impact on our specialty. Citation count is certainly not an absolute measurement of scientific quality, but the more citations a body of work obtains is reflective of the impact that the article has made on the scientific community. The top 100 most-cited breast articles in the plastic surgery literature have had a huge influence on the specialty as a whole and will likely be the ones that are remembered the most.

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