

The 100 Most-cited Articles in Abdominoplasty: A Bibliometric Analysis

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Background: Abdominoplasty is one of the most common aesthetic procedures performed globally. Research in this field is evolving, with recent emphasis on evidence-based surgery optimizing informed consent. This bibliometric analysis aimed to characterize emerging research trends and to assess the methodological quality of the highest impact abdominoplasty research.

Methods: The 100 most-cited articles in abdominoplasty were identified on Web of Science, across all available journals and years (1950–2019). Study details, including the citation count, main subject, and outcome measures, were extracted from each article by 2 independent reviewers. The level of evidence of each study was also assessed.

Results: The 100 most-cited articles in abdominoplasty were cited by a total of 2545 articles. Citations per article ranged from 206 to 34 (mean 65). Overall, 50 articles were assessed to be level of evidence 3, which is representative of the large number of cohort studies (n = 59) on the list. Similar numbers achieved levels 2, 4, and 5 (n = 16, 20, and 14), though none reached level 1. The main subject was operative technique in 50 articles, followed by outcomes in 34 articles. Only 7 articles utilized objective cosmetic outcome measures. Patient-reported outcome measures were employed in 25 articles, though only 5 incorporated validated questionnaires.

Conclusions: The most-cited research in abdominoplasty largely comprised low-to-moderate quality studies, with no article achieving the highest level of evidence. Contemporary high-quality evidence incorporating validated outcome measures is crucial to enhance shared decision-making, particularly in aesthetic procedures. (*Plast Reconstr Surg Glob Open* 2021;9:e3426; doi: [10.1097/GOX.0000000000003426](https://doi.org/10.1097/GOX.0000000000003426); Published online 26 March 2021.)

INTRODUCTION

Abdominoplasty remains one of the most common aesthetic procedures performed worldwide.¹ Indications for the procedure include: aesthetic improvement of the abdomen for both men and women; bariatric patients with excessive skin/pannus following significant weight loss; and significant skin and abdominal wall laxity following multiple pregnancies.^{2–4} Adequate reporting of both

clinical and patient-reported outcomes is fundamental for comprehensive outcome assessment.

Over the past 70 years, plastic surgery as a specialty has significantly developed. The increasing number of peer-reviewed plastic surgery articles being published reflect this evolution. Article citations serve as proxy for an article's impact and relevance of the scientific contribution to peers. Citation numbers also influence the reputations of the authors, institutions, and fundamentally the journal's impact factor, which equates to the number of citations received over the preceding year divided by the number of published articles over the past 2 years. A level of evidence is also often designated to published articles to denote the quality of study design.⁵

In the first comprehensive bibliometric analysis of articles published on abdominoplasty, we aimed to evaluate the quality and characteristics of the top 100 cited articles, and to highlight emerging research trends.

METHODS

A literature review was performed to identify the 100 most-cited articles on abdominoplasty. All journals

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available on an online database—Web of Science, version 5.33 (Clarivate Analytics, Philadelphia, Pa.)—were searched using the term “abdominoplasty” as a “topic” on 15 October 2019. The timespan set encompassed all years available (1950–2019).

The search yielded 2663 articles, which were subsequently ranked in descending order of “times cited.” Articles with an equal number of citations were separated by the average number of citations per year, with the more recent articles ranking higher. To ensure that the articles were directly relevant to abdominoplasty, 2 reviewers independently screened titles and abstracts until 100 articles were included. Discrepancies were resolved by consensus discussion with the senior author, with any remaining doubts settled by a review of the publication’s full text. A total of 230 articles were screened to provide 100 articles for inclusion. Reasons for exclusion of the other articles are specified in [Figure 1](#).

Data were independently extracted from full-text articles by 2 authors and entered onto a standardized computer spreadsheet (Microsoft Excel, version 14.7.7). Data extraction included article title, authors, publication year, source journal, total citations, mean number of citations per year, study setting, funding status, study design, level of evidence, main subject, and the use of clinical, cosmetic, and patient-reported outcome measures (PROMs). The level of evidence was assessed as per the Oxford Centre for Evidence-Based Medicine system (2011).⁶

RESULTS

The 100 most-cited articles on abdominoplasty were cited by a total of 2545 articles. (See [appendix, Supplemental Digital Content 1](#), which displays complete citations provided for all of the 100 most-cited articles. <http://links.lww.com/PRSGO/B589>.)

The number of citations per article ranged from 206 to 34 (mean 65), and the mean number of citations per article per year ranged from 12 to 0.87 (mean 4.21) ([Table 1](#)). The most highly cited article, published by Grazer and Goldwyn in 1977, was a cross-sectional study of 958 surgeons to determine the major and minor complications of abdominoplasty, including the mortality rate.⁷ Nahas was the most prolific author with 8 articles (with 5 as the first author and 3 as a co-author), followed by Ferreira with 6 (all as a co-author), and Matarasso with 5 (all as the first author).

Some 50 of the most-cited articles were published between 2000 and 2009, with the other decades producing much smaller outputs. (See [figure, Supplemental Digital Content 2](#), which shows the number of the 100 most-cited articles by decade. <http://links.lww.com/PRSGO/B590>.) The decade with the least output was the 1970s (n = 5), despite contributing the highest cited article.

The highly cited articles were published in 14 journals, with “Plastic and Reconstructive Surgery” featuring the most (n = 55), followed by “Aesthetic Plastic Surgery” (n = 11). The other journals contained <10 articles each. (See [table 1, Supplemental Digital Content 3](#), which shows the journals contributing the 100 most-cited articles. <http://links.lww.com/PRSGO/B591>.) Plastic surgery formed the focus of 7 of the journals, collectively contributing 87 articles,

with each of the remaining journals focusing on a different discipline.

Most of the studies were undertaken at a single-centre (n = 84) rather than in a multicentre setting (n = 16). Of the latter, 14 (87.5%) were performed in the USA. Overall, 54 articles originated in the USA, followed by 16 in Brazil. (See [table 2, Supplemental Digital Content 4](#), which shows the countries contributing the 100 most-cited articles. <http://links.lww.com/PRSGO/B592>.) Only 6 articles reported receipt of formalized funding, with the rest either unfunded (n = 15) or not stated in the article (n = 79).

Half of the articles were assessed to be of level of evidence 3, which is representative of the large number of cohort studies (n = 59) on the list. Similar numbers of articles achieved levels of evidence 2, 4, and 5 (n = 16, 20, and 14, respectively), though no article reached the level of evidence 1 ([Fig. 2](#)). Of the cohort studies, 34 were retrospective and 25 were prospective. The remainder of studies comprised 18 case-series and 6 expert opinions, with other study designs utilized in <5 articles each ([Fig. 3](#)).

The main subject was operative technique in 50 articles (46 surgical and 4 anesthetic/analgesic), followed by outcomes, which was the focus of 34 articles ([Table 2](#)). Articles on surgical technique focused on the abdominoplasty procedure itself (n = 23), adjunctive procedures (n = 9), and the choice of suture material (n = 14). Prognostic studies commonly investigated risk factors, such as smoking and obesity, on wound complications (n = 4 of 7).

Clinical outcome measures were used in 90 of the most-cited articles. However, only 7 employed objective cosmetic outcome measures, consisting of 6 locally devised grading classifications (eg, poor/fair/good/excellent) and 1 Strasser scale.⁸ More articles (n = 25) employed PROMs but only 5 (20%) incorporated validated questionnaires, such as the Rosenberg self-esteem scale (n = 3).⁹ Only 1 article used photographs as the primary outcome measure (in the context of 5 case reports), with a further 4 stating the use of photographs as a secondary measure.

DISCUSSION

To the best of our knowledge, this is the first bibliometric analysis comprehensively reviewing abdominoplasty research. The most-cited articles predominantly described a variety of surgical techniques employed in abdominoplasty. Study designs mainly comprised single-centre cohort studies and case series, thus precluding achievement of the highest level of evidence. There was a paucity of robust objective cosmetic assessments and validated PROMs. Nevertheless, plastic surgery journals contributed most of the highest impact research, consolidating abdominoplasty as a core procedure in the plastic surgeon’s repertoire, whilst offering insight into emerging research areas within this exciting field.

These findings are consistent with a large bibliometric analysis evaluating the quality of the plastic surgery literature over a 10-year period.¹⁰ Although significant improvements in methodological quality were observed over time, most articles were of low-to-moderate quality due to the use of suboptimal study designs.¹⁰ The inherent barriers to achieving the highest level of evidence are

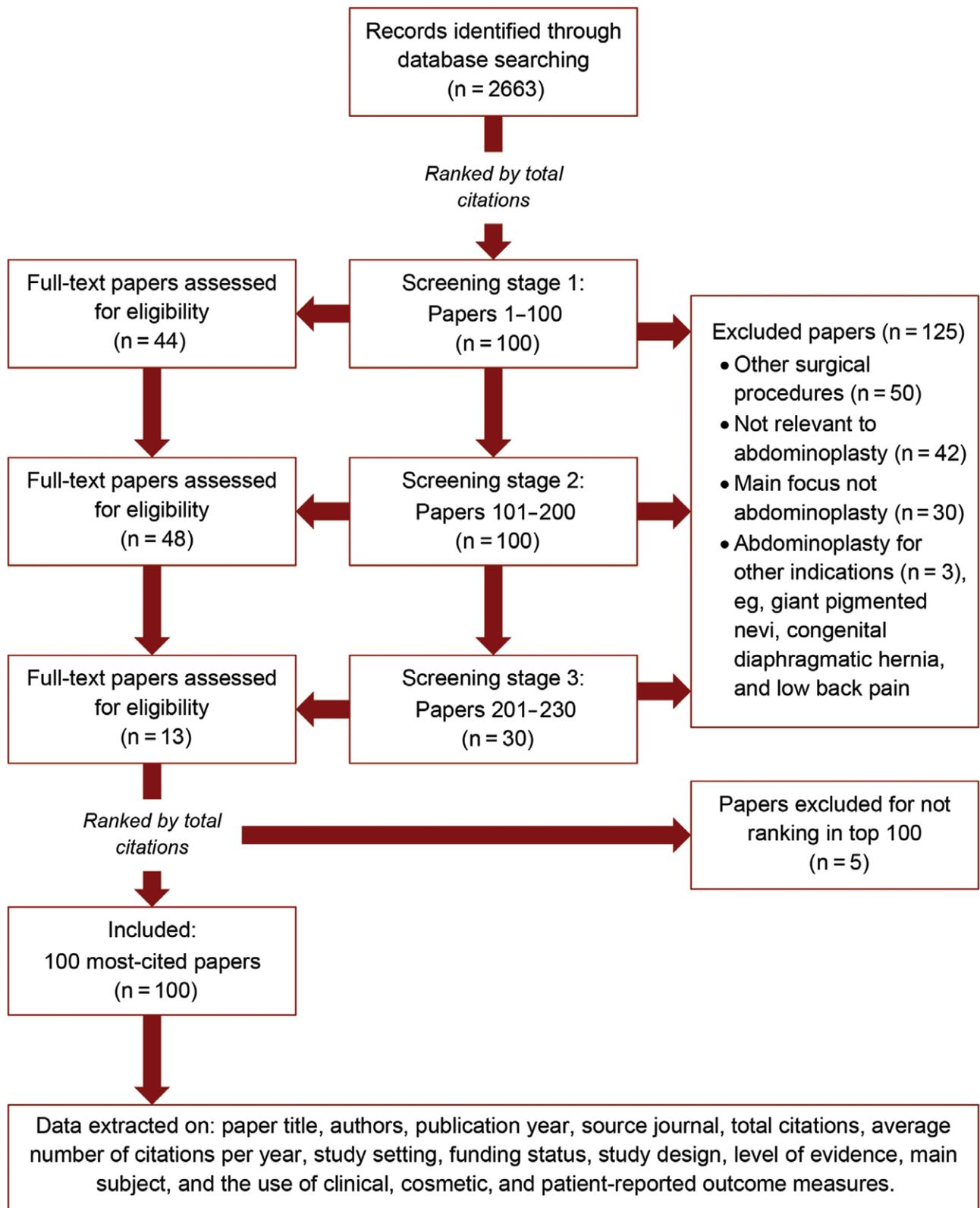


Fig. 1. Summary flowchart of methodology.

Table 1. The 100 Most-cited Articles on Abdominoplasty*

Rank	Study	Total Citations	Mean Citations per Year
1	Grazer and Goldwyn	206	4.79
2	Teimourian and Rogers	149	4.81
3	Vastine et al	143	6.81
4	Pollock and Pollock	140	7
5	van Uchelen et al	136	7.16
6	Baroudi and Ferreira	136	6.18
7	Hensel et al	131	6.89
8	Neaman and Hansen	129	9.92
9	Hatef et al	128	10.67
10	Manassa et al	128	7.53
11	Lockwood	126	5.04
12	Stewart et al	116	8.29
13	Matarasso	113	4.52
14	Hester et al	113	3.65
15	Dillerud	112	3.73
16	Bolton et al	109	6.41
17	Chaouat et al	99	4.95
18	Matarasso	99	3.41
19	Keyes et al	97	8.08
20	Kim and Stevenson	96	6.86
21	Matarasso et al	88	6.29
22	Nahas et al	85	6.54
23	Furuya et al	84	7
24	Momeni et al	82	7.45
25	Alderman et al	80	7.27
26	Saldanha et al	79	4.65
27	Warner and Gutowski	77	7
28	Andrades et al	75	5.77
29	Voss et al	75	2.21
30	Regnault	74	1.64
31	Bozola and Psillakis	72	2.25
32	Mitchell et al	71	5.92
33	Floros and Davis	69	2.38
34	Grazer	68	1.45
35	Matarasso	65	3.25
36	Ramirez	65	3.25
37	Nahas	62	3.26
38	Zecha and Missotten	61	2.9
39	Winocour et al	57	11.4
40	Saldanha et al	57	3
41	Fang et al	55	5.5
42	Matarasso	55	1.77
43	Dubou and Ousterhout	55	1.31
44	Khan	54	4.5
45	Nahas et al	53	2.3
46	Kryger et al	51	3.19
47	Christman	51	1.5
48	Costa-Ferreira et al	50	5
49	Cintra et al	50	4.17
50	Heller et al	50	4.17
51	Pollock and Pollock	48	6
52	di Martino et al	48	4.8
53	Fracalvieri et al	48	3.69
54	Le Louarn and Pascal	48	2.4
55	Saldanha et al	47	4.27
56	Andrades and Prado	47	3.62
57	Illouz	47	1.68
58	Gravante et al	45	3.46
59	Dellon	45	1.29
60	Papadopoulos et al	44	5.5
61	Nahas et al	44	2.93
62	Nahas et al	43	2.26
63	van Uchelen et al	42	2.21
64	Shestak	42	2
65	Neaman et al	41	5.86
66	Mayr et al	41	2.56
67	Pollock and Pollock	41	2.56
68	Baroudi et al	41	0.89
69	Coldiron et al	40	3.33
70	Strauch et al	40	2.86
71	Lockwood	40	2.5
72	Rohrich et al	40	2.35
73	Greminger	40	1.21
74	Najera et al	39	4.33

(Continued)

Table 1. Continued

Rank	Study	Total Citations	Mean Citations per Year
75	Antonetti and Antonetti	39	3.9
76	Rosen	39	3.9
77	Lazar et al	39	3.55
78	Araco et al	39	3.25
79	Spiegelman and Levine	39	2.79
80	Mohammad et al	39	1.77
81	Morales et al	38	5.43
82	Swanson	38	4.75
83	Yoho et al	38	2.53
84	Wilkinson and Swartz	38	1.12
85	van der Beek et al	37	4.11
86	Hatef et al	37	3.7
87	Al Qattan	37	1.61
88	Singla et al	36	12
89	Swanson	36	4.5
90	Graf et al	36	2.57
91	Bercial et al	35	4.38
92	de Brito et al	35	3.5
93	de Altneida Mendes et al	35	2.69
94	Huang et al	35	2.69
95	Malic et al	35	2.69
96	Massiha et al	35	1.52
97	Horch	34	6.8
98	Sforza et al	34	3.78
99	Le Louarn	34	1.42
100	Birdsell et al	34	0.87

*See appendix, Supplemental Digital Content 1, where complete citations are provided for all articles. (<http://links.lww.com/PRSGO/B589>.)

well-recognized within surgical specialties, with aesthetic surgery (in particular) traditionally pioneered by innovative, albeit under-powered, experimental research.¹¹ Although abdominoplasty contains the second greatest number of high-level of evidence studies amongst aesthetic disciplines (14%), this falls far short of rhinoplasty (51%).¹²

Level of evidence 1 research principally involves robust systematic reviews of randomized controlled trials (RCTs), with homogeneity, and high-quality RCTs. However, challenges in the application of more sophisticated study designs in abdominoplasty involve a mixture of financial, logistical and ethical considerations. Multicentre RCTs are expensive to implement, complicated by difficulties in securing funding, as shown in the present review.¹²⁻¹⁴ In systematic reviews, heterogeneity and subjectivity in outcome measures further impedes meaningful comparison of data in informative pooled meta-analyses.¹⁵ Regardless of this, interpretation of these results may still be limited by potential discordancy between patient and surgeon evaluations of cosmetic outcomes.¹⁶

Ultimately, a randomized format is simply not feasible for many surgical research questions, with both surgeons and patients reluctant to trial novel cosmetic procedures with unproven efficacy or safety profiles.¹⁷⁻¹⁹ Unsurprisingly, the 2 highest cited articles we report, by Grazer and Goldwyn⁷ and Teimourian and Rogers,²⁰ were both early cross-sectional studies defining the complication rates of abdominoplasty based on national surveys of plastic surgeons. Grazer and Goldwyn's findings interestingly reflect the pre-liposuction era of abdominal contouring surgery,⁷ whereas the subsequent work of Teimourian and Rogers has been significant in endorsing

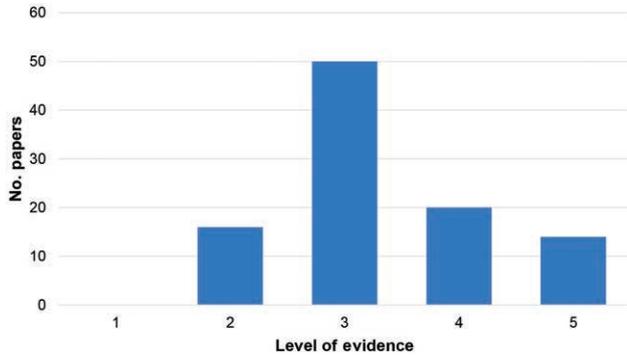


Fig. 2. Levels of evidence of the 100 most-cited articles.

the comparatively lower-risk profile of suction lipectomy.²⁰ However, both surveys demonstrated low response rates of 15% and 34.7%, respectively.^{7,20} As for all cosmetic procedures, establishing patient safety is paramount. Unfortunately, whilst acknowledging that one must first do no harm, managing patients’ ever-increasing aesthetic expectations is a key factor predisposing to surgeon burn-out, error, and subsequent litigation.^{21–23}

Wide variations in surgeon experience and peri-operative preferences also hinder the pursuit of evidence-based aesthetic surgery. The lack of definitively superior surgical techniques is exemplified by a lack of community equipoise, and multifactorial considerations guiding patient selection.^{17,24} Notably, almost half of the most-cited research in abdominoplasty described various modifications to surgical techniques and their perceived benefit to patient safety. Two of the top 10 ranked articles described suture techniques that reduced the incidence of local complications, such as seroma.^{25,26} The most cited of these,

Table 2. Main Subjects of the 100 Most-cited Articles

Main Subject	No. Papers
Surgical technique	46
Outcomes	34
Prognosis/risk factors	7
Anesthetic/analgesic technique	4
Anatomy	4
Non-operative management	2
Pathology	1
Psychology	1
Public health	1

Pollock and Pollock, promoted and later validated the use of progressive tension sutures (PTS), which facilitate tension-free closure of the abdominal flap.^{26,27} By effectively eliminating the dead space, avoiding drain insertion and enabling early ambulation, major risk factors for both local and systemic complications are addressed.²⁶ Optimization of wound healing naturally results in improved scar cosmesis. However, consensus does not currently exist in the choice of interrupted or running sutures.²⁸ Increasing the number of sutures, thereby reducing the risk of seroma, must also be considered alongside the risks posed by increased operative time. Therefore, meta-analyses evaluating these features are necessary to inform future practice.

The incorporation of externally validated outcome measures is another characteristic of high quality research. Similar to other aesthetic surgery disciplines, validated surgeon-assessed cosmetic outcomes and PROMs were poorly reported in our analysis.^{29,30} Whilst this may reflect surgeon choice, in which preferences for individual techniques is complemented by individualized outcome measures, this precludes inter-study standardization such

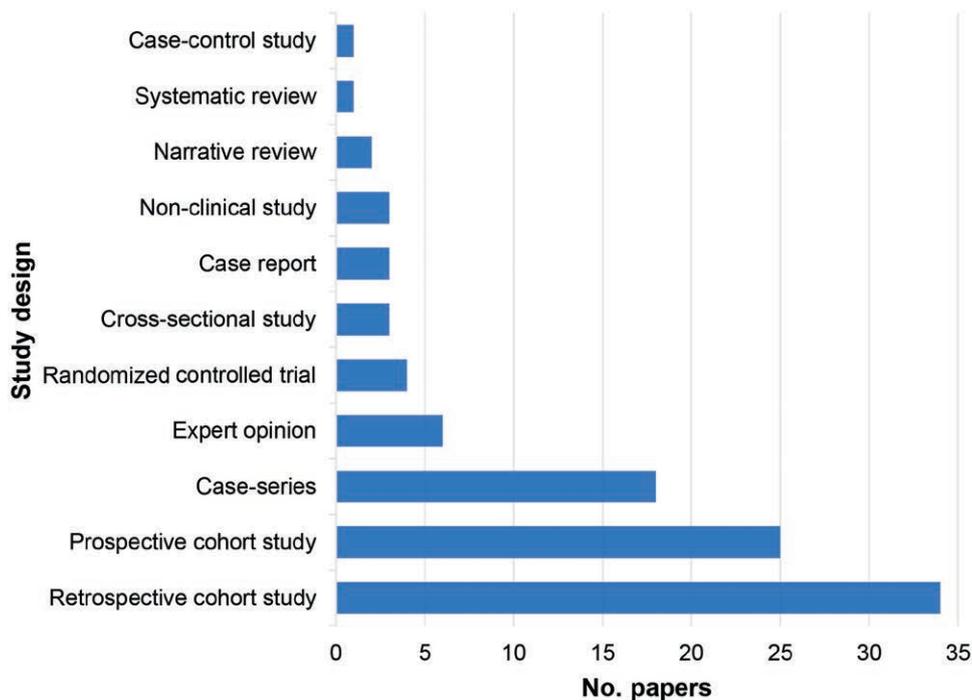


Fig. 3. Study designs of the 100 most-cited articles.

that comparability cannot be established at either the procedural or outcome level. Although aesthetic surgery involves considerable individualistic artistry, comparability is of singular importance with critical implications on the regulation of providers who often work in less-supervised, private settings.³¹ Therefore, it is encouraging that PROMs were increasingly used in the most recently published, highest cited abdominoplasty research.

Most importantly, procedure-specific PROMs, such as BODY-Q, represent the patient's perception of appearance, quality of life, and treatment experience, thereby facilitating patient-surgeon discussion on the realistic outcomes of aesthetic surgery.^{32,33} The Royal College of Surgeons recommend the routine collection and reporting of PROMs in abdominoplasty pre and postoperatively.³⁴ Therefore, the universal adoption of PROMs is warranted in future abdominoplasty studies to empower patients and inform shared decision-making.

Reassuringly, temporal analysis suggests that plastic surgeons remain at the forefront of high-impact abdominoplasty research.³⁵ This is likely due to their proficiency and license to perform abdominoplasty for a wide range of cosmetic and reconstructive indications. Conversely, non-plastic surgeons generally restrict their practice to specialty-specific indications, such as post-bariatric surgery. The significant contributions of the USA and Brazil are to be expected given that a third of all abdominoplasties are performed in these 2 countries alone.³⁶ When ranked by surgical cosmetic procedures performed by country, abdominoplasty is placed highest (third) in these 2 countries also, suggesting a greater focus and subsequent influence on global practice.³⁶ The promotion of academic surgery in the USA, supplemented by substantial financial and healthcare resources, may be attributable to its success.²⁹ On the other hand, aesthetically orientated Latin culture within a tropical climate has driven demand and competition between plastic surgeons to achieve and report finer results in Brazil.³⁷ Although issues with auto-citation and national bias, where authors are more likely to cite research from their own country, have been raised previously, this is unlikely to confound our analysis, considering these countries' accepted standing in the field of abdominoplasty.²⁹

Limitations of this study include those inherent to bibliometric analyses. Firstly, citation choice is open to partiality, namely citation bias, distortion, amplification, and invention, which may collectively result in the unfounded authority of certain publications.³⁸ Although constructing a citation network to investigate this was beyond the scope of this review, we analyzed only the most-cited research, thus minimizing the effect of such bias. Secondly, neither level of evidence nor citation count equates to a study's overall quality or importance of findings. A lower level of evidence does, however, weaken confidence in its results. Therefore, readers are encouraged to critically appraise the methodological rigor of each study and subsequently determine its impact on surgical practice.

Despite these limitations, an extensive search of the literature was conducted and the articles presented here may be considered seminal in advancing abdominoplasty research. Emerging research trends emphasize patient benefit, with descriptions of modifications to surgical

techniques, to improve patient safety and aesthetics, and an increased implementation of PROMs. However, methodological quality was overall lacking. A concerted effort is hence required to ensure that future studies are methodologically sound, which would enhance confidence in their findings. Surgeon-modifiable factors such as the standardization of techniques and validated outcome measures will be crucial in establishing abdominoplasty as an evidence-based aesthetic specialty.

CONCLUSIONS

The most-cited research in abdominoplasty largely comprised low-to-moderate quality studies, with no article achieving the highest level of evidence. Emerging research areas include modifications to surgical techniques resulting in superior safety profiles and overall cosmesis. Therefore, future studies should strive to present high quality evidence, integrating validated outcome measures, to verify these results and guide shared decision-making.

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