Eric Swanson

Evidence-Based Body Contouring Surgery and VTE Prevention

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Evidence-Based Body Contouring Surgery and VTE Prevention *and its sister publication,* Evidence-Based Cosmetic Breast Surgery*, are dedicated to my wife, Cindy, who remains my most ardent supporter and most discerning critic. There have been many times when this work seemed too large and too diverse to complete. Cindy has patiently endured my long absences in the office assembling research data. These books are the culmination of that work.*

A big thanks goes to my patients, who have placed their confidence in me. Given the importance of appearance, there is hardly a more sincere gesture of trust, and it is a responsibility that I do not take lightly. Most of what I know has been learned from my patients, not textbooks. My patients have cooperated with dozens of clinical investigations, including outcome studies, laboratory studies, imaging with MRI and ultrasound, and repeated photographic sessions. There is no better education (and opportunity for surgeon humility) than interviewing patients and asking for their feedback. Experienced plastic surgeons understand that we do not teach our patients; our patients teach us.

Preface

This is the first publication to include the words “body contouring surgery” and “evidence-based” in the same title. Plastic surgery textbooks are often titled some variation of “The Art of Plastic Surgery.” This volume, like its sister publication, *Evidence-Based Cosmetic Breast Surgery*, focuses on science, relying on data rather than expert opinion. The source material has been published in the major peer-reviewed plastic surgery journals. Many of the conclusions challenge the status quo. The importance of evidence-based medicine is the theme of not only Chap. 1 but all of the chapters.

Body contouring surgery is generally understood to mean surgery of the trunk and extremities, not the face, neck, or breasts. Accordingly, breast surgery, head and neck procedures, and labiaplasty are not included in this volume.

Like *Evidence-Based Cosmetic Breast Surgery*, this single-author volume is open to criticism that it represents the experience and prejudices of one surgeon. My purpose in writing is not to recite the mainstream view but to challenge it. Existing textbooks are composed of many chapters written by well-known contributors describing their “how I do it” methods. This old habit makes for thick textbooks. A recently published textbook on body contouring surgery exceeded 600 pages. What is the reader to make of all this often conflicting information? It seemed to me that almost everything plastic surgeons “know” about body contouring surgery is based on clinical impressions (Table 1). The old adage has merit—what we measure we improve, and vice versa.

My interest in the scientific evaluation of body contouring surgery began in 2002. I realized that many basic questions about liposuction, and body contouring in general, remained unanswered, despite the fact that liposuction was the most common plastic surgical operation and had been in general use for 20 years. Although the effect seemed obvious, there was a lack of any studies quantifying the effect of liposuction on the fat layer. Magnetic resonance imaging in volunteer liposuction patients provided the answers (Chap. 2).

Many investigators subscribe to the popular view that fat redistributes after surgery. In 2011, an article appeared in *The New York Times*, reviewing an article published in *Obesity*, stating that fat came back, not to the original locations, but rather to untreated areas of the upper body, making women look like linebackers. The researchers were not deterred by the lack of any known physical mechanism that could account for such a phenomenon. Photometric studies exposed the myth of fat redistribution (Chap. 2).

Table 1 Things we "know" that are wrong

1	Individual risk stratification
2	Chemoprophylaxis
3	Danger of combined procedures
4	Operating time as an independent risk factor
5	Skin tightening with radiofrequency
6	Skin tightening with VASER
7	Laser treatment of cellulite
8	Laser liposuction
9	Cryolipolysis
10	Fat redistribution theory
11	Breast enlargement after liposuction
12	Safety of silicone buttock implants
13	Trivial blood loss after liposuction
14	Electrodissection as opposed to scalpel dissection
15	Scarpa fascia preservation
16	Limited-dissection abdominoplasty
17	Microfocused ultrasound for skin tightening
18	Prone patient positioning
19	General endotracheal anesthesia with paralysis
20	Rectus plication and DVT risk
21	Garments and DVT risk
22	Efficacy of sequential compression devices
23	Bupivacaine toxicity when used in wetting solution
24	Nerve blocks for abdominoplasty
25	Rectus abdominis intrafascial injections
26	Liposomal bupivacaine
27	Pain pumps
28	Gluteal autoaugmentation
29	Intramuscular fat injection of buttocks
30	Subrectus abdominis implants
31	Implantable mesh
32	Floating the umbilicus
33	Inverted-T abdominoplasty scar
34	Injections to dissolve fat
35	Reliability of meta-analyses
36	Practicality of randomized studies in surgery
37	Quilting sutures
38	Tumescent versus superwet technique
39	Routine screening for coagulopathies
40	Body-Q

Outcome studies were missing. Without this information, how could one answer the most basic patient questions, such as, How painful is liposuction or a tummy tuck? Or, when can I return to work? How likely is it that my expectations will be met? Patients are happy to provide the answers (Chaps. 3 and 6). Patient questions can be answered with data. Surgeons' opinions are notoriously optimistic.

When I undertook my studies, some state medical boards were imposing limits on liposuction aspirate volumes despite a general belief that blood loss was miniscule, based on the small amount of blood in the suction canister. Estimated blood loss calculations determined from postoperative hematocrits proved this misconception woefully inaccurate (Chap. 5). Third space blood loss (into the tissues) was much greater than expected and just as important hemodynamically as if the blood had been lost externally.

Popular belief holds that bupivacaine, a more potent and longer-lasting local anesthetic than lidocaine, is dangerous. Yet, there were no studies evaluating plasma bupivacaine levels after plastic surgery. The findings, contained in Chap. 5, revealed a surprisingly wide margin of safety. This is good news for surgeons who wish to provide long-lasting pain relief without ineffective and possibly dangerous pain pumps or nerve blocks. Liposomal bupivacaine is expensive and unnecessary. The body's fat cells act as a bupivacaine slow-release mechanism or "physiological pain pump."

What were the metabolic effects of liposuction? When I undertook this particular study, I believed that the blood tests would confirm the null hypothesis. After all, how could subcutaneous fat removal have any systemic metabolic effect? Not only did I find that it did, but the change appeared to be a healthy one, with a dramatic drop in triglyceride levels in patients with at-risk levels to start with. Another unexpected (and favorable) finding was that the white blood cell count significantly decreased after liposuction. This finding was made completely by serendipity. White blood cells were being counted along with red cells by the automated blood cell counters. These positive effects remain largely unappreciated by plastic surgeons and the public (Chap. 4).

As in cosmetic breast surgery, the literature is full of articles giving the surgeon's practice preferences to reduce complications. For abdominoplasty, these include a limited dissection to preserve blood vessels supplying the abdominal skin flap and preservation of the Scarpa fascia. The notion of limiting the dissection hardly seemed to require a formal study. The findings of a controlled study using laser perfusion to compare a limited and full dissection defied first principles (Chap. 6). Limiting the dissection to a tunnel does not significantly improve flap perfusion after all. Scientifically, this finding should not be surprising; it simply confirms the angiosome theory. There is no substitute for data.

There is no substitute for data.

Quilting sutures are increasingly used to limit the dead space and reduce the risk of seromas after abdominoplasty. A logical alternative, and one supported by clinical studies comparing electrical and scalpel dissection, is to limit the tissue injury by avoiding electrodissection (Chap. 6).

Nonsurgical alternatives to liposuction are a recurring theme. Many plastic surgeons believe that nonsurgical treatments will eventually replace surgery.

Proper scientific evaluation must take precedence over business considerations alone (Chap. 11). Otherwise, patients and surgeons risk disillusionment.

Venous thromboembolism (VTE) is a very serious topic, deserving of its own chapters (Chaps. 12 and 13). Individual risk stratification and routine chemoprophylaxis are a case study in patient management dictated not by factual evidence but by the perceived need to conform to guidelines. In debating this topic last year with Dr. Guyatt, the lead author of the 2012 guidelines of the American College of Chest Physicians, I was reminded of the story of the emperor who wore no clothes. Unfortunately, the term "evidence-based medicine," coined by Dr. Guyatt himself, has become a cliché, like "validated." Readers do well to decide for themselves the quality of the evidence and validity of a study and question the authors' claims.

Individual risk stratification and chemoprophylaxis have largely gotten a free pass in the literature because these concepts represent the conventional wisdom, but a growing body of evidence shows, repeatedly, the failings of this approach: the lack of a scientific foundation for Caprini scores, the undisclosed financial conflicts, the misrepresentation of meta-data, the unjustified statistical adjustments, etc. The closer one looks, the worse it gets for those who believe in our ability to predict affected individuals and safely prevent VTEs by preemptively anticoagulating patients. But there is a silver lining: an opportunity to discard a nonscientific approach, learn more about the natural history of this problem, correct some bad (anesthesia) habits, embrace new technology (ultrasound), and make surgery safer for our patients. Ultrasound surveillance represents a new disruptive technology that has applications in the plastic surgery office that go well beyond early detection of deep venous thromboses (Chap. 13).

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Leawood, KS, USA Eric Swanson, MD

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About the Author

Dr. Eric Swanson completed medical school and a residency in plastic and reconstructive surgery at the University of Toronto before starting private practice in Kansas City in 1989. Dr. Swanson is an outspoken advocate for evidence-based medicine. Dr. Swanson's self-funded clinical research has produced over 120 publications in the top peer-reviewed plastic surgery journals, including numerous articles and letters that challenge the conventional wisdom and offer science-based alternatives. In 2017, Dr. Swanson published the book *Evidence-Based Cosmetic Breast Surgery*.

Dr. Swanson is a frequent lecturer and panelist at national and international meetings and regularly provides instructional courses in cosmetic breast surgery and body contouring surgery. Dr. Swanson is a member of the American Society of Plastic Surgeons, the American Society for Aesthetic Plastic Surgery, and the American Association of Plastic Surgeons.

Evidence-Based Medicine and Conflict of Interest

1

Abstract

Conflict of interest represents a major obstacle to advancement in our specialty. About half of US physicians receive payments from pharmaceutical or medical device companies. Publications in our scientific journals are important marketing tools for manufacturers. New transparency laws make it easier to check for large payments to physicians. However, there are many other indirect ways that companies can reimburse investigators.

Conflicts are not just financial. Physicians may have an intellectual conflict if they become outspoken advocates. Our journals and societies are vulnerable when companies become partners and support society functions and journal publications. Expert witnesses have a medicolegal conflict once they testify regarding the standard of practice.

Randomized studies are rarely practical in surgery. Meta-analyses suffer from confounding variables. Fortunately, prospective observational studies can provide reliable information, particularly when the method includes consecutive patients, a high inclusion rate, defined eligibility criteria, and a reliable measurement device. Patient satisfaction is the determinant of success in cosmetic surgery and may be assessed with patient-reported outcome studies.

No discipline can benefit more from critical thinking than cosmetic surgery, which is often (unfortunately) regarded as an art rather than a science. Evidence-based medicine sets aside conventional wisdom, first principles, and clinical impressions. Eventually, strongly held beliefs give way to the facts.

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Introduction

I have previously written regarding the limitations of the artistic model for cosmetic surgery [1] and the importance of evidence-based medicine in evaluating cosmetic breast surgery [2]. The need is no less in body contouring surgery. This discussion starts with conflict of interest and ends with an appeal to plastic surgeons to recommit to the principles of evidence-based medicine.

Conflict of Interest

Financial conflicts represent the most important problem facing evidence-based medicine today [2]. The link between commercial funding and study conclusions is undeniable in our specialty [3, 4]. Luce [4] writes, "conflicts in ethically problematic situations are those in which the practitioner participates in clinical investigation of new devices/technology, publishes that experience, and, in parallel, is paid a consultant's fee by the manufacturer."

Physician speakers are deemed more credible spokespeople than company representatives and are frequently paid to participate in symposia at our national meetings or locally at company-sponsored dinners [4]. Companies partner with our societies and even help fund journal supplements, blurring the separation of science and advertising. Peer-reviewed publications are linked to the financial growth of the company [4].

In considering a remedy, Luce [4] proposes that plastic surgeons with conflicts be excused as manuscript discussants and reviewers. He considers a more stringent editorial policy that would ban authorship of a scientific publication by individuals with a financial conflict of interest in the drug, device, or technology under study. True transparency would include disclosure of the magnitude of the compensation, in dollars [4]. Such a ban is widely presumed to be impractical, especially by those who have conflicts.

Can devices truly be evaluated without paying the investigators? Of course they can, as evidenced by my own work (Fig. 1.1) and the research efforts of many others without financial conflicts. Recent examples include the work of Hall-Findlay and her study of 626 patients and the incidence of seromas after insertion of Biocell (Allergan plc, Dublin, Ireland) implants [5] and Hidalgo and Weinstein and their randomized study of round versus shaped implants in 75 patients [6]. The findings of these studies challenge those of industry-sponsored publications.

What about the reward for the investigator? The investigator should find that publication of his or her research in a highly respected peer-reviewed journal and the accolades that come with it more than adequate compensation. Such recognition is likely to boost his or her professional standing, which can positively impact one's career.

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For too long, plastic surgeons have allowed themselves to be manipulated by industry. How often have we heard the moderator at meetings ask the attendees to visit the exhibits, "without which none of this (i.e., the meeting) would be possible?" Well, of course it would be possible. The physician-industry complex has gone on so long plastic surgeons find it difficult to imagine an arms-length relationship. Is it possible to function without the corrupting influence of industry sponsorship? Surgeons might have to pay more to attend meetings. Present meeting registration costs are trivial, about the same as a pair of breast implants. The prices of devices and implants would fall as companies are relieved of the tremendous financial burden (millions of dollars [4]) of payments to physicians and societies and continuing medical education activities. Any extra meeting expenditure, or paying for one's own dinner (surely we can afford it), would be compensated by reduced prices. The net financial

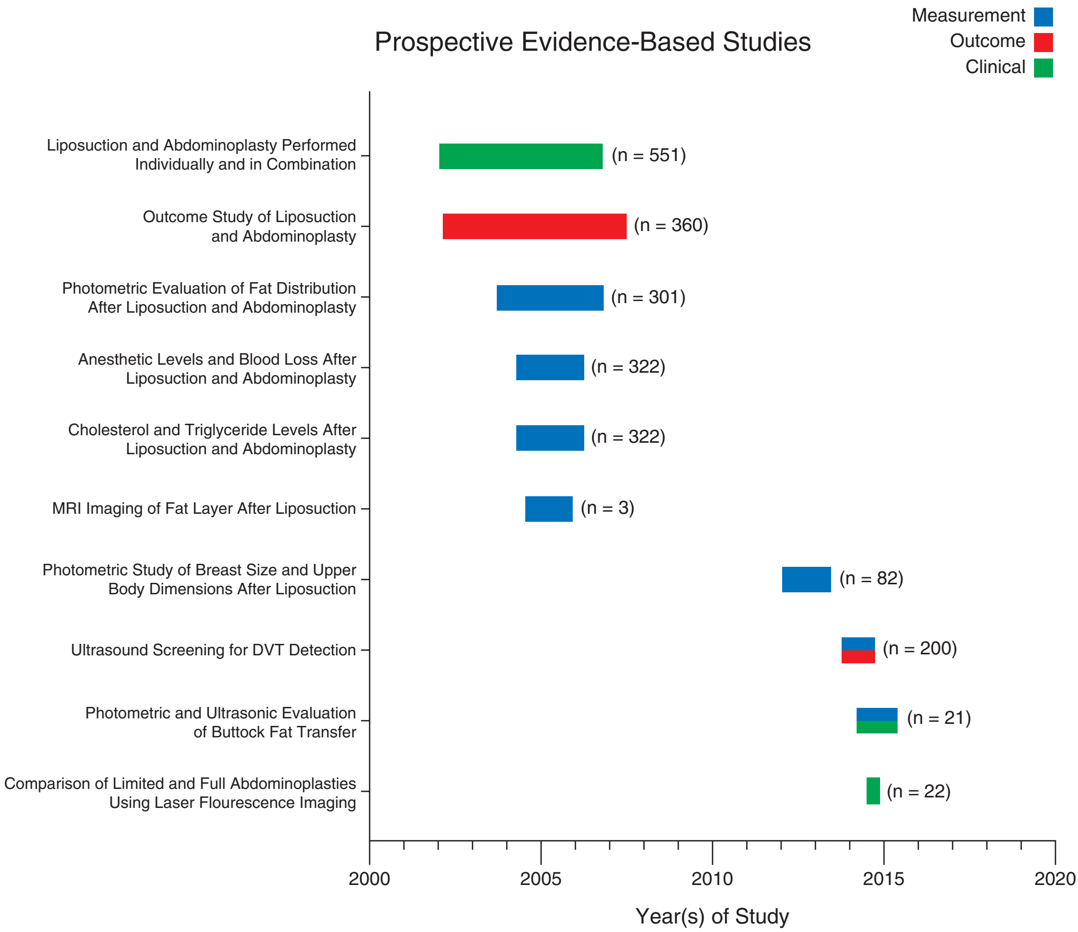

Fig. 1.1 Evidence-based measurement, outcome, and clinical studies undertaken by the author to learn more about the efficacy and safety of body contouring surgery

effect would be zero, but the integrity of our specialty would benefit tremendously.

Conflicts are not always just financial. Once an investigator becomes outspoken about an issue, he or she has an intellectual conflict. An investigator with numerous publications that are based on a faulty premise (e.g., Caprini scores, or a 14-point plan for reducing the risk of breast-implant-associated anaplastic large-cell lymphoma) may be unwilling to recognize the problem because of the consequences to his reputation. Our professional societies and journals may be confronted by a similar issue in determining website content, journal commentary, research funding, and awards. Once guidelines have been published, it is hard to backtrack.

Expert testimony can create a particularly insidious conflict of interest. For example, some plastic surgeons are willing to testify that individual risk stratification and chemoprophylaxis represent the standard of care and nonconformers are negligent, with tremendous consequences to patients, families, surgeons, and our insurance carriers (and therefore all of us). That surgeon is now forever conflicted because it is impossible to undo the consequences of wrongful testimony.

Expert testimony can create a particularly insidious conflict of interest.

Financial Disclosure

At meetings, surgeons often remark, "I have no relevant conflict of interest" or "I have no conflicts that would affect the content of my presentation." Some speakers will show a long list of conflicts and suggest that because they have so many, they are at least equal opportunity conflicters. Some investigators believe that if they previously received money but no longer receive payments, they are no longer conflicted and state "I have no disclosures." Is there an expiry date for financial conflicts?

Commercial affiliations may even be regarded as a badge of honor, reflecting one's status as a well-known and respected investigator. New transparency regulations help to inform the public regarding payments made to physicians [7].

> New transparency regulations help to inform the public regarding payments made to physicians.

Unfortunately, it is not difficult to sidestep such reporting requirements. A well-known investigator may be given a device (e.g., a VASER ultrasonic liposuction machine) at a heavily discounted price or even for free. A breast implant manufacturer may provide its researchers with complimentary or heavily discounted implants. There are many ways to reimburse surgeons indirectly. These considerations are substitutes for reportable cash payments, and they undermine the integrity of our research.

Remarkably, according to the *Journal of the American Medical Association*, about half of US physicians and 61% of surgeons received payments from the pharmaceutical and medical device industries in 2015, amounting to $2.4 billion. Any form or amount of compensation can influence prescribing behavior [8, 9]. At a recent meeting of the *American Society for Aesthetic Plastic Surgery*, four pages of fine print enumerated financial conflicts reported by the faculty.

It is possible for investigators to function as highly paid consultants or unbiased investigators but not both. It does not matter how well-meaning the investigator is. This is simply a reality of human nature—we do not bite the hand that feeds us. An example of this quid pro quo is to be found in the current debate regarding textured breast implants, which have been linked to anaplastic large-cell lymphoma (ALCL). Investigators with financial conflicts support the continued use of these devices and rely on a 14-point plan to reduce risk [10]. Investigators without financial links to the manufacturers oppose their continued use in women [11–13]. As physicians, we cannot accept a "buyer beware" philosophy.

Investigators who are not only passive investors but company officers and shareholders [14] have a financial obligation to the company. A fiduciary responsibility makes it impossible to remain objective [15].

FDA Clearance and Financial Conflict

When a device receives clearance by the US Food and Drug Administration, it is labeled with a stamp of authority that is reassuring to the public. This label also serves as a potent marketing tool. Unfortunately, the approval process is not protected from commercial influence. For example, Coolsculpting gained FDA clearance for treatment of the thighs based on studies performed by investigators that received major financial reimbursement [16]. The company itself was allowed to conduct ultrasound and photographic imaging [17]. The lead investigator was at one time a Zeltiq Aesthetics Inc. (Pleasanton, CA) paid consultant and shareholder [17] and reportedly now operates 26 Coolsculpting devices [18]. Zeltiq was purchased in 2017 by Allergan plc (Dublin, Ireland) for $2.48 billion [19].

Plastic surgeons are responsible for scientifically evaluating new devices. This obligation cannot be outsourced. Making important acquisitions based on commercial considerations alone is likely to lead to patient and surgeon disillusionment [20]. Critical appraisal of new products is discussed in Chap. 11.

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The Scientific Method

A disregard of the scientific method has real consequences that affect patient care and, in some cases, their lives. Even the plastic surgeon's life can be devastated by wrong assumptions (e.g., in the case of venous thromboembolism prevention). Proper methodology is not complicated. It starts with consecutive patients, a reasonable inclusion rate, and an objective measuring device (Tables 1.1 and 1.2) [21].

Surprisingly, measurements have not reached the mainstream in our discipline. Not only do plastic surgeons not measure their results, but many do not wish to measure their results. Even today, well into the twenty-first century, it is possible to sit through an entire day of presentations on any subject in cosmetic surgery without seeing a set of standardized photographs and measurements. One of our journal editors commented at a recent meeting, "It's aesthetic, so evidence-based medicine does not apply." An upcoming meeting sponsored by one of our professional societies promotes not just speakers and moderators but "pundits," who opine like political commentators. No wonder the same debates take place at our meetings year after year. The noted American statistician, Deming, [22] commented, "Without data you are just another person with an opinion."

> *Without data, you are just another person with an opinion.*
>
> – Deming.

Evidence-based medicine considers expert opinion and first principles (e.g., "it makes sense that…") to represent the lowest level of evidence.

Table 1.1 Cosmetic level of evidence and recommendation (CLEAR): description of levels and recommendations

Level	Description	Recommendation
1.	Randomized trial with a power analysis supporting sample sizes	A
2.	Prospective study, high inclusion rate (≥ 80%), and description of eligibility criteria Objective measuring device (i.e., not surgeon's opinion) or patient-derived outcome data Power analysis if treatment effect is compared No control or comparative cohort is needed if effect is profound	A
3.	Retrospective case-control study using a contemporaneous control group Prospective clinical study with an inclusion rate < 80% Prospective study without controls or comparison group and a treatment effect that is not dramatic	B
4.	Retrospective case series of consecutive patients Case/control study using historical controls or controls from other publications Important confounder that might explain treatment effect	C
5.	Case report, expert opinion, nonconsecutive case series	D

Table 1.2 Grade of recommendation

A	Conclusion strongly supported by the evidence, likely to be conclusive
B	Conclusion strongly supported by the evidence
C	Moderate support based on the evidence
D	Inconclusive based on the evidence presented

[Reprinted from Swanson E. Levels of evidence in cosmetic surgery: analysis and recommendations using a new CLEAR classification. Plast Reconstr Surg Glob Open 2013;1:e66. With permission from Wolters Kluwer Health.]

Even the most accepted clinical impressions require a scientific foundation. For example, it seems to make sense that anticoagulating patients after surgery would reduce their risk of a deep venous thrombosis. However, studies undertaken to support chemoprophylaxis are not only inconclusive but some show the opposite effect [23].

Plastic surgeons for years have discussed the importance of preserving medial row perforators and Scarpa fascia when performing abdominoplasty, based on first principles. It makes sense that, by preserving more blood vessels, perfusion of the flap is optimized. Similarly, it stands to reason that, by preserving the Scarpa fascia, lymphatic drainage channels are protected and seromas avoided. A rigorous controlled laser perfusion study and a cadaveric anatomical study expose the failings of clinical impressions and first principles [24, 25] (Chap. 6).

Measurements are the missing link in objective analysis (Fig. 1.1). In many ways, evidence-based medicine is measurement-based medicine [2]. What we measure we tend to improve, and vice versa.

> Measurements are the missing link in objective analysis. In many ways, evidence-based medicine is measurement-based medicine. What we measure we tend to improve, and vice versa.

When he stepped down as the longtime former editor of *Plastic and Reconstructive Surgery*, Goldwyn [26] worried most about commercial influence and keeping the specialty "pure." He cautioned the incoming managing editor that he would need a strong sense of ethics because "you'll need them in this business." Goldwyn, quoting his father, wrote: "It is amazing how easy it is to be truthful if one wants to be." [27].

In a recent discussion published in *Plastic and Reconstructive Surgery*, Lista [28] commented, "Our careers as plastic surgeons typically began with an undergraduate degree in sciences, where we studied the scientific method and the principles of systematic observation, measurement, and experimentation, and the formulation, testing and modification of hypotheses. We then went to medical school, where we learned the idea of scientific skepticism, that claims need to be reproducible and supported by empirical research. However, as soon as we become plastic surgeons practicing aesthetic surgery, all that annoying scientific stuff was thrown out the window."

Such observations can certainly cause cynicism. It is time we return to our role as scientists and scholars. Such a renewed commitment is not only good for our patients but good for us because it is the only path to patient satisfaction and the future well-being of our specialty.

> It is time we return to our role as scientists and scholars.

Meta-Analyses

A meta-analysis is considered the highest level of evidence [21]. Systematic reviews combine data from numerous studies, providing large sample sizes. Large sample sizes are statistically desirable because they reduce the likelihood of error, particularly a type II (false negative) error [21]. Such studies are particularly valuable when there are few confounding variables.

Unfortunately, plastic surgery is full of confounding variables, and therefore our specialty is largely unsuitable for meta-analyses. For example, three meta-analyses were recently published within the space of a few months on the subject of seroma rates after abdominoplasty [29–31]. Confounding variables undermined the conclusions (Chap. 6).

A meta-analysis of venous thromboembolism (VTE) in surgical patients, published in *Annals of Surgery*, contained a bewildering number of confounders, including cancer diagnosis, type of surgery, anesthesia, method of VTE detection, follow-up time, and the use of sequential compression devices [23]. Over 1000 patients did not even have surgery.

Studies that minimize confounding variables are likely to be more reliable. Using the example of seroma rates, a study done by operators using the same method but varying one variable—the use of electrodissection—is likely to produce a reliable conclusion [32, 33].

Prospective Observational Studies

Randomized studies are suitable for the study of nonsurgical methods such as the use of drains or for the study of commercial fillers, for example. They are not suitable for studies of plastic surgical operations because patients have the freedom to choose their operation and cannot be forced to participate in randomization. As patients are excluded from the randomized group, generalizability is compromised [21]. Equipoise may be difficult to achieve [21]. A Catch-22 exists in that it is unethical to knowingly recommend an inferior treatment to a patient and it is pointless to conduct a study evaluating an operation that is believed to be no better than the existing standard [21]. Fortunately, well-done observational studies can provide the information we need.

Prospective studies are considered a higher level of evidence than retrospective studies [21]. The outcome is unknown at the beginning of the study, reducing the opportunity for bias. Some studies are inaccurately labeled prospective despite the fact that the data have already been gathered when the study is undertaken. Such a study is retrospective, by definition.

A notable example of bias is provided by a recent study supporting a 14-point plan to reduce the risk of BIA-ALCL [10]. The eight authors grouped together their favorable experience inserting macrotextured breast implants and (allegedly) the 14-point plan in 21,650 women. Of course, the outcome was already known. No doubt the experience of another group of eight surgeons not using the 14-point plan and reporting no cases of BIA-ALCL could have been gathered just as easily.

A disadvantage of a prospective study is that it cannot be done in a week or two. The study must be designed, institutional review board approval obtained, and data collected using well-considered eligibility criteria over a period of time (Fig. 1.1). Prospective studies avoid cherry-picking patients that conform to the authors' preferred outcome. They also give the investigator the opportunity to be surprised by the findings.

Prospective studies avoid cherry-picking patients that conform to the authors' preferred outcome. They also give the investigator the opportunity to be surprised by the findings.

Outcome Studies

Plastic surgeons do not have a particularly good track record when it comes to asking patients for their opinion of the result. In most surgical disciplines, a successful outcome is not subjectively defined. However, in cosmetic surgery, the outcome is measured by patient satisfaction [21]. The author's staff has conducted in-person surveys with >1000 patients. There is no better education for surgeons than asking for patient feedback. Unfortunately, the Q-tests, such as the Body-Q [34], do not provide useful clinical information. Questionnaires should be surveys, not psychometric tests [21]. Really, plastic surgeons, and the surgery, are being evaluated, not the patient. In the absence of an accepted generic survey, ad hoc surveys provide clinically useful information and can be used to compare procedures (e.g., liposuction and abdominoplasty) (Chaps. 3 and 6).

It is not difficult for a surgeon in either academic or private practice to undertake prospective clinical, outcome, and measurement studies (Fig. 1.1). The author hopes that the next generation of plastic surgeons will honor their scientific pedigree and make plastic surgery the evidence-based specialty that it should be.

Courage is rightly esteemed the first of human qualities… because it is the quality which guarantees all others.
– Winston Churchill [35].

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2 The Myth of Fat Redistribution

Abstract

Some investigators believe that fat returns after liposuction. To evaluate this possibility, the author undertook a prospective study among predominantly nonobese consecutive patients undergoing 301 liposuction and abdominoplasty procedures. Lower body dimensions were measured using standardized photographs taken before and at least 3 months after surgery.

The average weight change was a loss of 2.2 lbs after lower body liposuction ($p < 0.01$) and 4.6 lbs when combined with abdominoplasty ($p < 0.001$). Liposuction significantly reduced abdominal, thigh, knee, and arm width ($p < 0.001$). Midabdominal and hip width were more effectively reduced by liposuction and abdominoplasty than liposuction alone ($p < 0.001$).

There was no difference in upper body measurements when comparing patients who had simultaneous liposuction and/or abdominoplasty with patients who had cosmetic breast surgery alone. Measurements in patients with at least 1 year of follow-up ($n = 46$) showed no evidence of fat re-accumulation. Both liposuction and abdominoplasty are valid techniques for long-term fat reduction and improvement of body proportions. There is no evidence of fat regrowth.

Similarly, some investigators suggest that liposuction may cause breast enlargement. To evaluate the possibility of secondary breast hypertrophy and fat redistribution after liposuction, 82 women were enrolled in a prospective controlled study. No significant increases in upper pole projection, breast projection, or breast area were found in patients treated with liposuction alone and those who received liposuction plus abdominoplasty. Neither liposuction nor abdominoplasty produces secondary breast enlargement.

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Introduction

A lack of rigorous study limits our present understanding of fat distribution after liposuction. The effect of liposuction on the thickness of the lower body subcutaneous fat layer has been determined by magnetic resonance imaging [1]. Surveys document patient satisfaction and a subjective awareness of a reduction in body size in treated areas [2, 3]. In 2012, the author published a quantitative photometric analysis of liposuction and abdominoplasty in a large number of patients [4].

Previously, a deficiency in our knowledge base allowed for the promulgation of different opinions regarding postoperative fat distribution, including the concept of "fat return" [2, 5, 6]. A widely publicized study published in *Obesity* in 2011 claimed that fat redistributes after liposuction, leaving treated areas of the lower body and re-accumulating in untreated areas of the upper body [6], including the upper abdomen, shoulders, and triceps [7]. A 2011 report in the *New York Times* [7], featuring an artist's caricature of this idea (Fig. 2.1), was widely publicized on the Internet [8, 9]. The patient looks like a linebacker after surgery. In addition, several studies based on surveys suggest that women's breasts tend to enlarge after liposuction [10–15], but physical measurements were lacking [16].

A Prospective Measurement Study of Fat Redistribution

To investigate the possibility of fat redistribution to untreated areas of the upper body after liposuction, the author undertook a prospective measurement study among 301 consecutive liposuction and abdominoplasty cases (294 patients) that met the inclusion criteria, which included (1) liposuction or abdominoplasty, with no simultaneous thigh lift, (2) photographs at least 3 months after surgery, and (3) no subsequent surgery between the surgery date and the date of the postoperative photographs [4]. The usual reason for exclusion was no follow-up visit 3 months or more after surgery. There were 426 liposuction and abdominoplasty procedures performed during this time

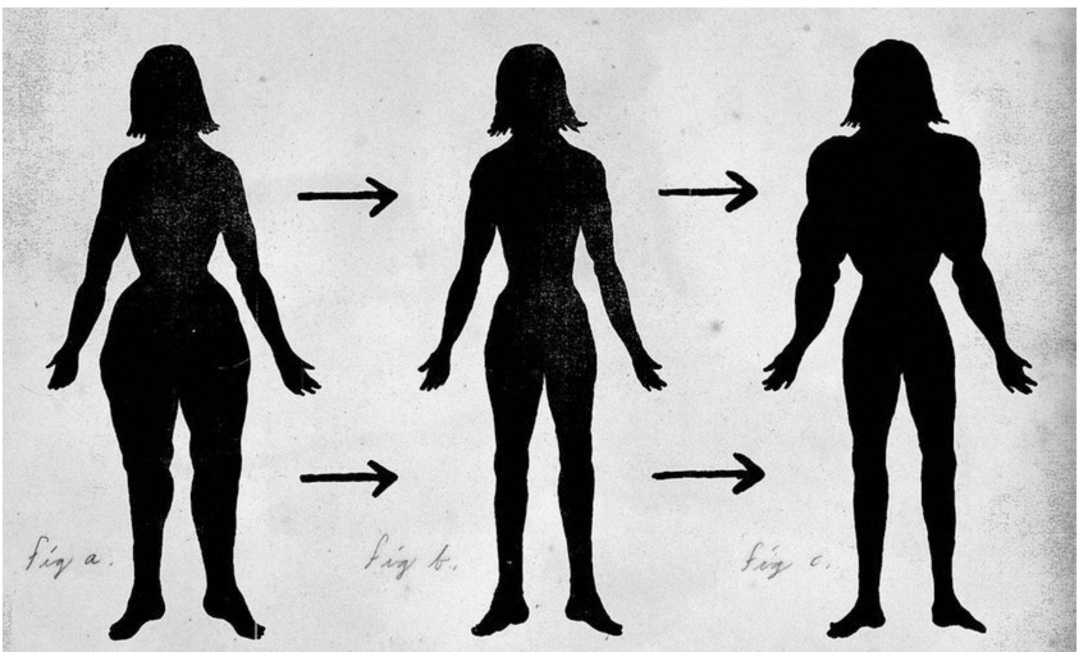

Fig. 2.1 *New York Times* artist's caricature of body shape changes after liposuction [7] as proposed by Hernandez et al. [6]. This concept recognizes a lasting effect of liposuction on the thighs but postulates compensatory regrowth in the abdomen, shoulders, and arms [Courtesy of Jonathon Rosen]

Fig. 2.2 Size- and orientation-matched photographs of a 24-year-old woman before (*left*) and 1 year after (*right*) liposuction of her lower body, arms, and axillae and a breast augmentation. The total aspirate volume was 3250 cc. Measurements show a reduction in width at each of the treated levels (the calves were not treated). Magnetic resonance imaging measurements of this patient are provided in Fig. 2.10 [Reprinted from Swanson E. Photographic measurements in 301 cases of liposuction and abdominoplasty reveal fat reduction without redistribution. Plast Reconstr Surg. 2012;130:311e–322e; discussion 323e–324e. With permission from Wolters Kluwer Health]

period, for an inclusion rate of 70.7%. This study did not evaluate breast size changes. Breast size was evaluated in a separate measurement study [16] and is described later in this chapter.

The superwet technique and the Lysonix 3000 (Mentor Corp., Santa Barbara, CA) ultrasonic system were used for all liposuction procedures. Commonly, lower body liposuction was performed, treating the abdomen, flanks, thighs, and knees (Fig. 2.2). The abdomen and flanks were treated in men (Fig. 2.3). All abdominoplasties included umbilical transposition, and all except one (99%) were primary abdominoplasties (Fig. 2.4). Mini-abdominoplasties were excluded. Rectus abdominus fascial plication was performed in all abdominoplasties using two layers of monofilament polypropylene sutures. Most abdominoplasties (89%) were performed with simultaneous liposuction of the abdomen and flanks. Details of the surgery and anesthesia are provided in Chaps. 3 and 5, respectively.

Photographs and Measurements

To ensure standardization [17], all digital photographs were taken in the same room, using the same background, lighting, body positioning, focal distance, and 60 mm camera lens. All preoperative photographs were taken on the day of surgery. Measurements were made at the same level of the upper abdomen (narrowest level, just below the costal margin), mid-abdomen (umbilical level), hip (iliac crests), outer thighs (greatest width), knees (medial femoral epicondyles), and calves (greatest width), using the Canfield 7.1.1

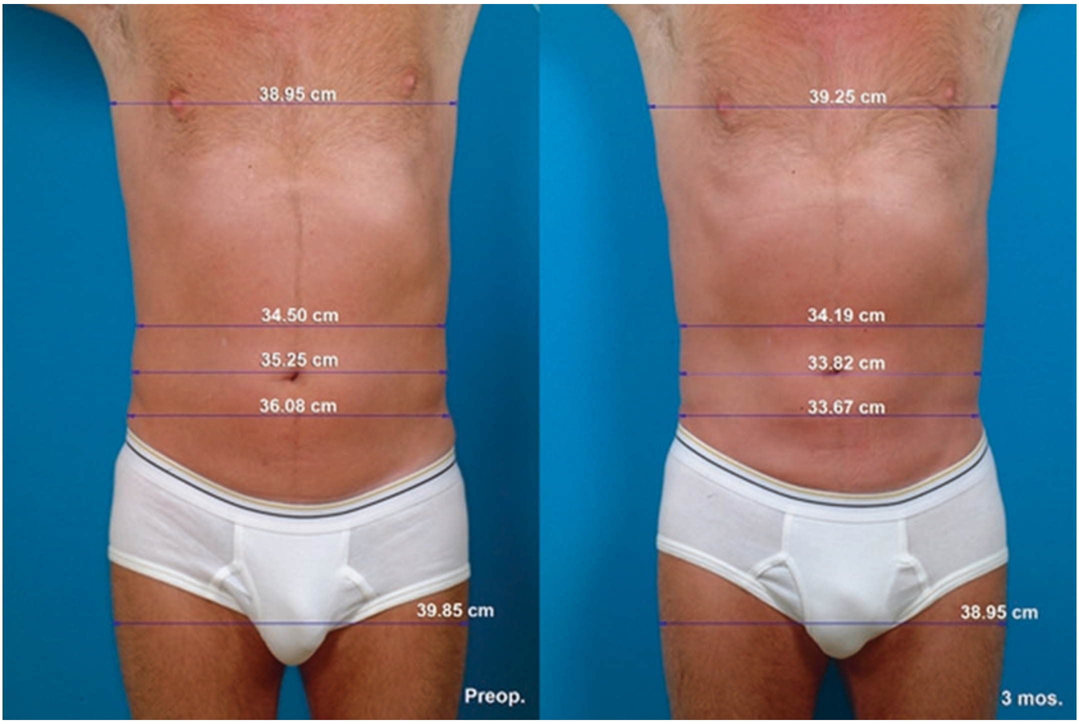

Fig. 2.3 Size- and orientation-matched photographs of a 62-year-old man before (*left*) and 3 months after (*right*) liposuction of the abdomen and hips. The aspirate volume was 1125 cc. The greatest reductions are at the level of the mid-abdomen and flanks

(Canfield Scientific, Fairfield, N.J.) imaging software. Arms were measured at the level of the deltoid insertion (Fig. 2.5). All patient weights were recorded on the day of surgery and at follow-up appointments using the same hospital scales.

Upper Body Measurements

Upper body dimensions were measured to investigate whether an increase in upper body size occurs after liposuction, as claimed by Hernandez et al. [6]. Among the 245 women who underwent liposuction and/or abdominoplasty, a subset of 67 women underwent simultaneous cosmetic breast surgery and had upper body photographs available at least 3 months after surgery. These images were used to measure changes in upper body (not breast) dimensions and to compare these measurements with a separate group of 78 consecutive women who underwent cosmetic breast surgery alone during the same study period. Measurements included (1) shoulder width, measured at the level of the preaxillary crease, (2) mid-humeral width, and (3) upper abdominal width (Fig. 2.6).

Although not specific, shoulder and mid-humeral measurements are expected to be sufficiently sensitive over a large number of patients to detect an increase in subcutaneous fat volume of the arms, triceps, and mid-axillary areas—sites where Hernandez et al. reported "trends for increases" [6].

Facial Measurements

Preoperative and at least 3-month postoperative facial photographs (n = 83) were compared and tested for reliability among study patients who had simultaneous facial procedures, usually submental lipectomies, excluding patients treated with facial fillers and facelifts (i.e., no procedures affecting facial volume).

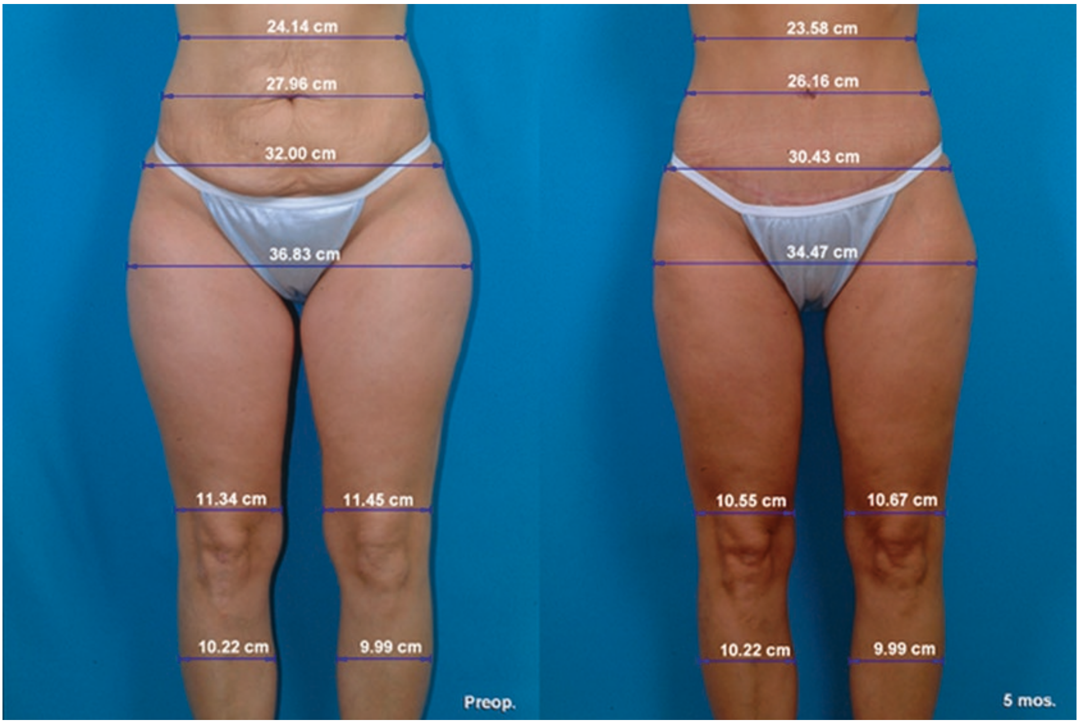

Fig. 2.4 Size- and orientation-matched photographs of a 32-year-old woman before (*left*) and 5 months after (*right*) abdominoplasty and liposuction of the lower body (not including calves). The aspirate volume was 1725 cc and the flap weight was 2.0 lbs. Measurements show a reduction for each of the treated areas [Reprinted from Swanson E. Photographic measurements in 301 cases of liposuction and abdominoplasty reveal fat reduction without redistribution. Plast Reconstr Surg. 2012;130:311e–322e; discussion 323e–324e. With permission from Wolters Kluwer Health]

Patient Weights

The proportion of obese study patients (body mass index ≥30 kg/m^2) was 19.3%, significantly less than the obesity rate for the American adult population (33.8%) at the time of the study [18]. The mean change in weight after liposuction of the lower body was a loss of 2.20 lbs and 4.58 lbs when combined with an abdominoplasty ($p < 0.001$) [4].

Lower Body Dimensions After Surgery

The combined data revealed significant reductions at all three trunk levels after liposuction and abdominoplasty in women (Figs. 2.7 and 2.8), with significantly greater decreases at the mid-abdomen and hip levels for women treated with liposuction/abdominoplasty compared with women treated using liposuction alone ($p < 0.001$). Thigh, knee, and calf measurements were reduced in patients who had liposuction and in patients who did not have liposuction of these areas. The magnitude of the reduction, however, was significantly greater when the thighs and knees were treated ($p < 0.01$). Arm measurements were significantly reduced after liposuction ($p < 0.001$). Men experienced significant reductions at the mid-abdominal and hip levels after liposuction ($p < 0.001$), but not at the upper abdominal level, and there was no significant change for untreated thighs in men.