Practice Advisory on Gluteal Fat Grafting

Daniel Del Vecchio, MD, Jeffrey Kenkel, MD

Practice Advisory on Gluteal Fat Grafting

Daniel Del Vecchio, MD; and Jeffrey Kenkel, MD

Dr Del Vecchio is a consultant surgeon, Massachusetts General Hospital, Boston, MA. Dr Kenkel is the program director, Division of Plastic Surgery, University of Texas Southwestern Medical School, Dallas, TX. Dr Kenkel is the editor-in-chief for *ASJ Open Forum* and the associate editor for *Aesthetic Surgery Journal*.

Corresponding Author: Dr Daniel Del Vecchio, 38 Newbury Street, Suite 502, Boston, MA 02116, USA.
E-mail: dandelvecchio@aol.com; Instagram: @uptownbodycontouring

Disclosures: Dr Del Vecchio receives royalties from Microaire (Charlottesville, VA, USA) and from Wells Johnson (Tucson, AZ, USA) for cannula designs and holds patents on fat transplantation devices which are not currently commercially available. Dr Kenkel receives research grants from Bellus Medical (Dallas, TX, USA), Venus Concept (Toronto, Canada), Allergan (Dublin, Ireland), and Brijjit Medical (Marietta, GA, USA).

Funding: The authors received no financial support for the research, authorship, and publication of this article.

Abstract

On January 31, 2018, The Multi-Society Task Force for Safety in Gluteal Fat Grafting released a Practice Advisory regarding gluteal fat grafting. The Task Force was assembled in the wake of several highly publicized patient deaths involving Brazilian Butt Lift ("BBL") and produced a second practice advisory in August 2019. In 2021 the ASAPS President commissioned a Working Group on BBL Patient Safety, charging the Group to address new guidelines affecting safety and welfare of BBL patients. The "Practice Advisory on Gluteal Fat Grafting" is the first advisory developed since the Working Group was formed. In addition to surgical technique as a major cause of fatal complications of BBL, the Working Group focused on micro-economic trends of operative time and regional BBL pricing and considered fatigue and distraction in formulating the current guidelines. In Florida the majority of BBL deaths occur at the end of the week. Such a non-normalized distribution most likely represents the result of fatigue and/or distraction, which has been linked to surgical mortality in multiple published communications. In addition, mortality is likely due to uncertainty or lack of documentation as to the correct plane of fat injection. Therefore, the newest and most compelling recommendations from these guidelines include the use of ultrasound-guided documentation of cannula placement prior to and during fat injection, and the limitation of 3 BBL cases as a maximum amount of total operative cases per day. The authors thank members of the Task Force for the insights they brought to this process.

The Multi-Society Task Force for Safety in Gluteal Fat Grafting (The Aesthetic Society, ASPS, ISAPS, IFATS, ISPRES), representing board-certified plastic surgeons around the world, released a Practice Advisory on January 31, 2018 (1). The Task Force was assembled in the wake of several highly publicized patient deaths involving Brazilian Butt Lift ("BBL") and increasing state legislative and regulatory activity of the BBL procedure. In addition, a publication in the Aesthetic Surgery Journal (2) stated a mortality rate for BBL of 1:3,000 cases, which has been quoted and referenced by multiple surgeons to be the "highest of any cosmetic surgery procedure" (3-5).

In response to the increased scrutiny of the BBL procedure, the Task Force produced a second practice advisory in August 2019, titled, Gluteal Fat Grafting Safety Advisory (3). Since the Task Force's inception, professional and public awareness of patient safety issues has continued to grow.

To meet this challenge, the current The Aesthetic Society President commissioned a Working Group on BBL Patient Safety, allowing the group to address new guidelines affecting the safety and welfare of BBL patients. The "Practice Advisory on Gluteal Fat Grafting" is the first advisory developed since the working group was formed.

For the Multi Society Gluteal Fat Grafting Task Force, it was a lengthy and challenging process for the committee, which included many experts and representatives from related plastic surgery organizations. Committee members included Peter Rubin M.D., Chair; Steve Teitlebaum M.D., Constantino Mendieta, M.D., Ricardo Rodriguez, M.D., Alan Matarasso, M.D., Onelio Garcia, M.D., James Fernau, M.D., Richard D'Amico, M.D., Rod Rohrich, M.D., Roger Khouri, M.D., Raul Gonzalez, M.D., Nelson Piccolo, M.D., Charles Thorne, M.D., Alexander Aslani, M.D., Dan Mills, M.D., Sydney Coleman, M.D., Hector Duran, M.D. Pat Pazmino, MD., Simeon Wall, Jr., M.D., Daniel Del Vecchio, M.D., Adam Katz, M.D., Kotaro Yoshimura, M.D., Renato Saltz, M.D., Michael Costelloe, Keith Hume, Katie Sommers, Sam Jejurikar, M.D., Andrea Pusic, M.D., Martha Zielinski, Michael Neumeister, M.D., Ozan Sozer, M.D., Arturo Ramirez Montanana, M.D., and Ashkan Ghavmi, M.D.

In general, there is little scientific evidence available on BBL patient safety performed in hospital operating rooms versus ambulatory surgical centers ("ASCs") versus office-based surgery suites, and none that specifically addresses BBL from the standpoint of fatigue and distraction. The research and published materials available focus more on the techniques and complications rather than on safety provisions. Therefore, this advisory is based on the best

information available and reflects a synthesis and analysis of expert opinion, clinical feasibility data, open forum commentary, and review of survey data (2,6).

Practice advisories are developed to assist physicians in clinical decision making and represent strategies for improved patient management. This practice advisory describes a range of generally acceptable approaches to diagnosis, management, or prevention of specific BBL complications, particularly Pulmonary Fat Embolism, (PFE"). This practice advisory attempts to define principles of practice that should meet the needs of most patients in most cases. However, this practice advisory should not be deemed inclusive of all proper methods of care or exclusive of other methods of care directed at obtaining safe and adequate results. It is anticipated that it will be necessary to approach some patients' needs in different ways. The ultimate decision regarding the care of a particular patient must be the direct judgement of the practicing physician attending to that patient. This practice advisory is not intended to define or serve as a standard of medical care.

The purpose of the present advisory is to use a combination of scientific evidence, empirical data, and common sense to provide a set of updated guidelines for practitioners performing BBL, or Gluteal Augmentation with Fat Grafting.

BBL BACKGROUND

Attempts to significantly enhance gluteal size and shape through exercise, padding, non-invasive "buttock enhancement" using HIFEM (High-Intensity Focused Electromagnetic) technology (7), use of FDA-approved biodegradable filler injections (8) and injection with silicone, acrylate, or other non-regulated substances (9) are unsuccessful and discouraging at best, and at worst, can lead to localized necrosis, multiorgan system failure and death (10). Gluteal Fat Grafting, a surgical intervention designed to treat projection, hip width and transitional harmony of the buttock-thigh interface, has proven to be a successful method of improving body contour.

The history of gluteal fat grafting has shown confusion in both the lay press and in peer review journals. The name "Brazilian Butt Lift" BBL has been attributed to Brazilian plastic surgeons (11), although there is no accurate or verifiable published evidence to substantiate this. Rather, the first published report of gluteal fat grafting was by Chajchir in 1989, showing a case of gluteal fat grafting for trochanteric depression in a 22-year-old female patient (12). Contrary to tabloid claims that Brazilian surgeon Ivo Pitanguy invented the procedure, "Brazilian Butt Lift" is directly attributed to Leonard Grossman, a Queens,

New York plastic surgeon, who first coined the term during a 1996 television presentation on the Learning Channel (13,14).

FAT GRAFTING TECHNIQUES

Over the years, a variety of terms have been used to describe gluteal fat grafting techniques. The relevant focus is on instrumentation and techniques as they may relate to PFE, as the other key elements of the fat transplantation process (15): harvesting, processing, and recipient site manipulation) are not directly related to the risk of PFE. A summary of these transplantation techniques follows.

Coleman Technique

Fat harvested from liposuction is dehydrated using a centrifuge and is transferred into multiple 1cc syringes prior to transplantation into the recipient site. Although this technique was effective for use in facial fat grafting - where restoration of volume lost is the goal - it is not practical for large volume fat grafting to the breast and buttocks (16).

Modified Coleman "Large Syringe" Technique

As injected fat volumes in the breast and the buttocks increased, so did the impracticality of 1cc syringes, which led to increasing syringe sizes. Over the past decade, syringes of 3cc to 60cc have been used to transplant fat into the gluteal region.

Syringes were invented and deployed for the injection of fluids, of which fat is not. Fat, a semisolid, requires a variety of syringe pressures to initiate and maintain steady flow, including:

1) dehydration of fat (viscosity)
2) size of cannula (smaller, higher pressure needed)
3) Size of syringe (larger, lower pressure possible)

The result is that the larger the volume of fat grafted, the more work the thenar muscles of the dominant (injecting hand) must do. This is exacerbated by "drier" fat, larger syringes and by smaller cannulas. This "dominant" hand is attached to the "dominant" elbow and shoulder of the same extremity that is driving axial "to and fro" motion during the syringe grafting process, as depicted in Figure 1. below. This is the same extremity that must employ proprioception and "feel" where the cannula tip is at all times to insure its subcutaneous location (Figure 1).

It has been shown in the orthopedic surgery literature that increased fatigue diminishes proprioception (17). Decreased proprioception of the dominant injecting hand can lead to inadvertent subfascial penetration, and subsequent placement of fat in undesirable planes.

Such fatigue can also result in a "two thenar approach" where the operator resorts to pushing the syringe with both hands, with no hand on the recipient site to feel for or to insure the cannula's subcutaneous position. The non-dominant hand is vital to assist in proprioception of cannula depth and location. This "two thenar" technique is not considered a safe or accurate technique to graft fat and should never be used, as depicted in Figure 2.

Expansion Vibration Lipofilling ("EVL")

Del Vecchio and Wall first described EVL as a more efficient alternative to syringe- based injection in large volume fat transplantation to the breast and buttock (18). Based on slanted cannisters instead of syringes, on initiating and maintaining fat flow using a roller pump instead of thenar muscles, employing basket cannulas and vibration to "navigate through recipient site tissue, and by using 4mm large bore tubing, they demonstrated that large volume fat transplantation procedures like BBL:

- can be performed more expeditiously
- frees the operating hand from thenar fatigue
- allows more focus on cannula tip location and anatomic cannula depth

PFE PREVENTION - TECHNOLOGIES

Ultrasound Assisted Fat Grafting Technique

The real-time use of ultrasound-guided cannula visualization has been described as a technique to transplant fat (19). In a series of 15 patients using awake epidural anesthesia, a two-surgeon approach was needed - one injecting and the other holding the ultrasound probe following the cannula. An average total transplanted volume of 528cc, was grafted and an additional 25 minutes to the “usual fat injection time" was reported. Total operative time was not reported. The authors suggest that this technique "may avoid injuring the deep vessels, further decreasing the risks of major complications". While radiologic imaging of cannula location may have theoretical merit, the impracticality of a two-operator execution would unlikely achieve widespread clinical adoption in its current form.

Liposuction, first introduced in the USA in the mid-1980s was a dangerous and bloody procedure with a mortality rate as high as 1:5,000 cases. Abdominal perforation was

reported as the second highest cause of death after thromboembolism (20). Therefore, a fundamental question one must ask of ultrasonic lipofilling proponents is: If it is important to see where the cannula tip is at all times when fat is being inserted, why is it not equally important to always see the tip of the cannula when fat is being removed?

A logical answer to this question follows. While subfascial perforation during liposuction does occur, the resultant impact is minimal unless one penetrates through the muscle and transgresses intraabdominally or retroperitoneally. With fat, simple fascial penetration can have disastrous impact because of the incoming direction of fat and fat migration (21). Claims regarding convexities of the buttocks and flatness of the abdomen resulting in differing dangers of cannula angles, and assertions that suctioning the waist and abdomen does not require ultrasound guidance because the abdominal muscle fascia is stronger than the gluteal fascia are less substantive and are speculative.

The use of ultrasound in gluteal fat transplantation has been further developed and championed by Pazmino. Leveraging subcutaneous fat migration concepts (21) targeting fat to the deep subcutaneous layer (subjacent to the superficial gluteal fascia, as seen in Figure 3. below), and executing a "single surgeon, single brain" immobile approach to cannula level documentation, improvements in gluteal shape can be achieved using less cannula movement and smaller volumes of graft, relying on Ultrasound-guided Lipofilling, Targeting Recipient Areas, or "ULTRA" BBL. The benefits of this technique include shorter ultrasound times, smaller volumes of fat required to achieve an overall aesthetic result as well as accurate graft placement, and certainty that the fat has been placed in the correct plane(s). Ultrasonic documentation of the procedure also serves to memorialize its safe execution and certifies the identity of the operating surgeon (Figure 3).

PFE - EARLY DETECTION

Fat emboli have been implicated as the number one cause of intraoperative BBL deaths (22). There are two mechanisms of pathophysiology regarding fat emboli (23), macroscopic fat emboli ("MAFE") and the other microscopic fat emboli ("MIFE"). In BBL cases, a mechanical blockage can occur when the rupture of deep intra-muscular and submuscular veins allow the entrance of macroscopic fat lobules into the venous circulation. The lobules are too large to pass through the pulmonary circuit, where they become trapped. Accumulation of obstructive fat in the pulmonary circuit eventually manifests as electromechanical dissociation, or "EMD". Intraoperative symptoms of fat embolus include

tachycardia, hypoxemia, and hypotension, unresponsive to fluid challenge or to pressors. Death is often intraoperative and occurs rapidly after the onset of EMD.

In contrast to a mechanical fat embolism, micro fat embolism syndrome manifests later and is an inflammatory and biochemical condition. In theory, the syndrome occurs when circulating or hydrolyzed free fatty acids in the pulmonary system damage the endothelial cells and pneumocytes. Symptoms can vary from mild dyspnea to adult respiratory distress syndrome, and usually occur within 24 to 48 hours after surgery. Treatment includes supportive critical care and, in some cases, the use of high doses of corticosteroids, ethanol, and albumin (24).

EMD from PFE is analogous to falling through the ice on a frozen lake- the moment it happens, it is too late. Besides the obvious prevention of venous injury through the technical avoidance of intramuscular or sub fascial fat transplantation (25), improved survival of PFE might be feasible if breach of the venous circulation could be diagnosed earlier, before the accumulation of fat lobules and EMD pathophysiology manifests.

POTENTIAL FUTURE DIRECTIONS

Early Detection Technologies – Macro Pfe

While prevention of macroscopic PFE through proper surgical technique is ideally the best way to eliminate BBL-related intraoperative mortality, the early detection of PFE could provide practitioners time for life-saving intervention, before fat accumulation results in death from EMD (26). The use of trans thoracic ultrasound as a monitoring device during anesthesia has been used to herald fat lobular particulate flow in the inferior vena cava during spinal and orthopedic surgery. Visualized fat emboli have been documented in the vena cava in such cases, allowing pre-EMD diagnosis and intervention (27). Future evaluation of this modality in routine BBL surgery may result in its use as an early detector of PFE.

Early Detection Technologies – Micro Pfe

Conversely, early detection of microscopic fat embolism syndrome could theoretically lead to earlier intervention of microscopic PFE with more rapid supportive care and improved clinical outcomes. In the immediate post-discharge period, a clothing device (Nanowear, Incorporated, University Park, Pennsylvania, USA), worn at home, continuously measures vital signs, including blood pressure, heart rate, temperature, respiratory rate, oxygen saturation, and cardiac output, and can be transmitted in real time via the cloud to central monitoring stations. In a recent study (28), 23 consecutive BBL patients monitored at home

postoperatively showed a wide range in hemodynamic responses to liposuction and BBL, supporting the premise that the physiologic stress of fluid shifts, blood loss, and epinephrine degradation (29) continue long after discharge from the outpatient ASC or office-based OR. By "bringing the PACU home", such monitoring may be beneficial to all patients who undergo liposuction and BBL and may improve outcomes for patients who experience micro fat embolism syndrome.

Recommendations

1. At the risk of omitting the obvious, it is imperative that fat transplantation to the gluteal region be restricted to the subcutaneous plane (30). Due to the increased operator hand and extremity fatigue associated with syringe injection of large volumes of fat, the Coleman technique is not recommended for volumes of fat grafted over 200 cc per buttock. At this point, thenar fatigue likely will begin and may impact proprioception and control of the tip location.

2. For larger volumes of fat over 200cc per buttock, non-syringe methods using infusion pump fat propulsion are recommended. Surgeons not familiar with the techniques of pump-induced propulsion or EVL should consider attending a technique-related training course.

3. Ultrasound-Guided Lipofilling, Targeting Recipient Areas, or "ULTRA" BBL is a novel technique that shows promise in assuring a subcutaneous deposition of fat and in documenting the safe performance of the procedure. ULTRA BBL should be learned by surgeons performing gluteal fat grafting and should be incorporated into their practices. Surgeons not familiar with the techniques of ULTRA BBL should consider attending a technique-related training course.

4. No one single fat transplantation technique is best suited for all patients in all circumstances. Factors such as the patient's overall health, the patient's body mass index, the estimated volume of fat to be grafted, and any other concomitant procedures to be performed should be considered by the surgeon to determine the best technique for the individual patient.

5. Intraoperative trans-thoracic ultrasound may show future promise as a standard for early detection of venous circulatory breach and macroscopic PFE, prior to fatal EMD physiology. Its utility and cost-effectiveness have yet to be studied.

6. Post-discharge home monitoring technology, when available commercially, may show future promise in the early detection of postoperative hemodynamic pathophysiology,

including micro PFE. Further studies showing the sensitivity and specificity of this monitoring system in the detection of associated morbidity must be investigated.

FAT GRAFTING CANNULAS

There is a wide variety of cannula designs, sizes and attachment standards used in the execution of large volume fat transplantation. It has been published that larger cannula diameters (cannula diameters than 4mm) are associated with lower mortality from pulmonary fat embolism (2). This may be explained by several possible causes, two of which will me mentioned here:

1) Larger cannulas are stronger, stiffer, and are less likely to undergo "flexibility misguidance" (18). On axial penetration, a slight bend in a flexible cannula or a bend at the syringe/cannula junction will continue to curve in the direction of the bend, leading to deeper and deeper tissue planes despite a superficial direction of the syringe by the operating surgeon.

2) Larger cannulas generate higher fat flow with less resistance, leading to less thenar fatigue per volume of fat grafted, when fat flow is driven by syringes.

Recommendations

1. No one cannula is best suited for all patients in all circumstances. However, it appears that large-syringe “Coleman technique” approaches involving Luer Lock attachments to syringes are more likely to lead to flexibility misguidance and to thenar fatigue and are prone to two-handed techniques. Therefore, these techniques should be avoided when grafting large volumes of fat (>200cc per buttock) into the gluteal region.
2. Larger cannulas (> 4mm) are more rigid and have a lower likelihood of flexibility misguidance.

ANESTHESIA

Various types of anesthesia or anesthesia combinations are appropriate for gluteal fat grafting depending on the overall health of the patient, the estimated volume of the fat to be grafted, and the postoperative care plan.

BBL under local anesthesia is becoming increasingly popular. This approach is often marketed, suggesting that the risk of PFE is lower because of the use of local anesthesia (31). Although it has been established that conscious sedation demonstrates better in-hospital and 30-day mortality rates for invasive procedures such as transcutaneous aortic valve

replacement (32), there is no evidence that local anesthesia results in a lower BBL mortality rate from fat PFE when compared to general anesthesia. In addition, sedation in the prone position is associated with increased risk of airway management problems as well as negative pressure pulmonary edema (33). This type of marketing, suggesting local anesthesia is a safer alternative, is often pursued by surgeons who do not have office-based operating facilities that are licensed to provide general anesthesia. By stating, "Awake Brazilian Butt Lift reduces the risks of the surgical procedure", physicians performing BBL under local anesthesia can turn a facility deficiency into a marketing advantage.

A review of the paper, "Brazilian Butt Lift Under Local Anesthesia: A Novel Technique Addressing Safety Concerns" (34) demonstrated 11 out of 34, or one out of three patients required additional surgery for unsatisfactory size increase, with an average volume of 359cc of fat grafted per buttock. This paper addressed the safety concerns of inadvertent intra or sub-muscular fat insertion, and suggested surgeons can stay subcutaneous, because awake patients would not tolerate intramuscular insertion of a cannula under local anesthesia. The paper focuses on the limitations of awake-BBL and does not imply awake-BBL carries a lower risk of pulmonary fat embolism.

Patient Selection

One of the most important aspects in the success of any surgical procedure is the physical condition of the patient and their anatomic and expectational attributes at the time of surgery. In the context of assessing BBL patients and their risk for undergoing surgical procedures, overall general health, locations of excess fat, concomitant desired procedures, and particular expectations all play key roles in the decision to offer surgery or not.

LIPOSUCTION VOLUME

Since the seminal article by Iverson and Lynch appeared in PRS almost 20 years ago (35), a 5000cc limit on aspirate volume remains the oft-quoted standard of care for liposuction limitations in an outpatient setting. Although refinements have been suggested, basing the maximum aspirate on BMI (36,37), the focus has remained on total aspirate and not on total volume of fat removed.

Liposuction is a traumatic exercise resulting in surface area trauma and fluid resuscitation dynamics. Separate considerations must be given to frank blood loss. Aspirate volume is a complex conglomerate of unabsorbed tumescent solution, blood, and fat lobules. 5000cc of relatively bloodless aspirate, comprised of 2000cc of relatively clear tumescent

fluid and 3000cc of fat may represent premature evacuation before full absorbtion of tumescence. This contrasts with a redo-liposuction case where 3000 cc of aspirate is comprised of 1500 cc of fat and 1500 cc of very bloody fluid. While the former is a higher volume of aspirate, the latter represents a much more dangerous situation. Checking the hematocrit of bloody aspirate fluid can be helpful to estimate blood loss and the curtailment surgery of necessary. Total aspirate, although the current benchmark, represents an oversimplification of tissue trauma and blood loss and should be replaced with more specific metrics. For the surgeon, a complete understanding of aspirate components, the fibrous nature of the subcutaneous fat, and surgical judgement is vital to safety and successful outcomes.

EXCESS, FATIGUE AND OPERATOR DISTRACTION

Florida, while having 7% of the US population, accounts for 28% of the country's BBL mortalities, as reported over a 5 year and 9 month period from 2011-2016 by Mofid, Teitlebaum et al (3). Either the BBL mortality rate in Florida is higher, more BBLs are being performed in Florida than its per capita share, or both. In any event, Florida is an outlier (38) as it relates to BBL mortality.

Miami, Florida is a 2-3 hour flight from the Dominican Republic, Mexico City, and Bogota, Colombia. Each of these destinations is replete with BBL providers. Attractive pricing options for BBL patients in South Florida are therefore abundant. This may explain why the average pricing for BBL in South Florida is 50% or less of the pricing in the Northeast United States. (39,40).

To approximate similar lifestyles, BBL practitioners in South Florida must perform twice as many BBL surgeries as their Northeast colleagues. While a surgeon can, with improved instrumentation and techniques, perform, 2-3 BBLs in one day, surgeons in South Florida are known to perform 7 or more BBLs in a day.

It has been shown that increased residency hours between 100 and 120 hours a week results in fatigue and increased medical errors (41). It is also known that increased surgical distraction in the form of operating on one's birthday (42) or operating at the end of the week (43) correlates with increased surgical complications, including fatalities. Considering a 3-hour BBL and a 1-hour OR turnaround time it is not unreasonable to expect a surgeon to perform three BBLs in an 11-hour day. Note: seven 3-hour cases per day, five days a week means 21 hours of surgery per day and exceeds 100 hours per week). It is possible to extrapolate that some may employ a "team" to treat these patients, assigning a specific role to each to each team member and shortening the procedure. For a surgeon going from room to

room inserting fat, this may be a way to perform seven cases in one day, but such fragmentation of duties may also increase distraction and confusion which could lead to misadventure. A "single surgeon" approach ensures the surgeon is aware of all aspects of the patient's care throughout the procedure, as they are present and actively performing surgery- for the entire procedure.

In prior analyses of BBL mortality, emphasis has focused on surgical instrumentation and technique. These were important steps in helping make this procedure reproducibly safer. It would be helpful to look at other epidemiological variables such as number of surgeries performed by the operating surgeon that day, case order of the fatality, day of the week of the surgery, and other variables that would be considered indicative of operator fatigue or distraction. Some variables were not obtainable by public access. Data regarding cases per day mortality case as a function of case order was not discoverable. An anecdotal mortality from June 16, 2021 occurred as a surgeon performed their seventh BBL procedure of the day, beginning their first case at 6:32 am and experiencing the case-7 intra-operative mortality at approximately 8:31 pm (44).

With the assistance of the State of Florida Board of Medicine, an independent audit of BBL fatalities in South Florida was undertaken over the past 24 months. A total of 12 deaths resulting from BBL in Florida over the past 24 months were evaluated for the frequency of deaths by the day of the week that the surgery had been performed (see Figure 4.).

While the numbers are low, the deaths do not follow a normal random distribution in relation to the days of the week. The majority of deaths (58%) are clustered toward the end of the week, whereas only one third of the deaths occurred at the beginning of the week. In addition, 100% of the beginning of the week deaths occurred on Monday, the first day after the weekend.

US highway fatality statistics (45) demonstrate a significant percentage of deaths are due to driver fatigue (9%) or distraction (9.5%). The Federal Motor Carrier Safety Administration mandates that truck drivers work a maximum of 11 hours a day; otherwise, they are in violation of the mandatory "hours of service" limitations (46).

Recommendations

1. Surgery, like trucking, is a useful exercise when properly performed; however, it can be fatal. The performance of BBL requires complete concentration and focus with no operator fatigue.
2. Factors that cause distraction (music, video, social media, visitors, room traffic, multiple surgeons) are to be minimized or avoided to ensure full surgeon concentration.

3. Factors that cause fatigue (lack of sleep, stress, number of BBL procedures performed in a day, in a week) should be taken into consideration as to minimize the risk of misadventure; a single surgeon should perform the entire procedure without the aid of assistants or technicians to harvest the fat.

4. The maximum number of BBLs that should be safely performed should be limited to 3 (three) a day. This limitation potentially decreases operator fatigue and distraction, resulting on less likelihood of surgical misadventure.

5. A "single surgeon" approach - where the operator is present and actively performing the entire procedure – is recommended.

An outline of the guidelines is summarized in Table 1.

CONCLUSIONS

For nearly two decades BBL has proven to be a safe, effective, and popular intervention for the treatment of lower body shape. BBL techniques have advanced from simple extension of the Coleman technique to more targeted and less fatigue-inducing methods of large volume fat transplantation and assurance of anatomic depth using radiographic imaging. Even with these advances, BBL should be performed only after adequate training, knowledge of the dynamic anatomy, and full surgeon comfort.

The surgeon has a choice of a variety of fat transplantation techniques, cannula designs, and anesthesia options. When selecting the most appropriate technique(s) for each individual patient, it is the surgeon's responsibility to weigh such factors as the anticipated liposuction volume, volume and location of transplanted fat, anesthesia route, facility type, and the patient's overall health status.

The management of the postoperative period is critical to the outcome of BBL. Qualified staff provide the appropriate post-anesthesia and postoperative care. Particularly in larger-volume cases, management of fluid and electrolyte balance, pain management, and monitoring for complications are important and the use of home-monitoring devices shows early promise as future potential standards of care.

When performed by a surgeon with a thorough knowledge of the pathophysiologic implications of this surgery, and by a surgeon who understands his or her own physical and cognitive limitations, gluteal fat grafting can be a safe procedure that results in significant patient satisfaction.

REFERENCES

1. Multi Society Task Force Bulletin. Accessed on worldwide web, 10 October, 2021 at: https://www.plasticsurgery.org/for-medical-professionals/advocacy/key-issues/fat-grafting-to-the-buttocks

2. Mofid MM, Teitelbaum S, Suissa D, et al. Report on Mortality from Gluteal Fat Grafting: Recommendations from the ASERF Task Force. Aesthet Surg Jour. 2017; 37(7):796-806. DOI 10.1093/asj/sjx004.

3. Thorne CH, M; Matarasso, A, Richter D, Coleman SR, Magalon G. Gluteal Fat Grafting Advisory, August, 2019. Accessed on the worldwide web 10 October, 2021 at: https://www.plasticsurgery.org/documents/Patient-Safety/BBL/Gluteal-Fat-Grafting-Safety-Advisory_Jun19.pdf

4. "Botched" Star Terry Du Brow Discusses BBL as the "Most Dangerous Procedure in Plastic Surgery" Accessed on the worldwide web 10 October, 2021 at: https://youtu.be/xyvFDLlDqFs

5. Ellin A. Brazilian Butt Lifts Surge, Despite Risks – The New York Times August, 2021. Accessed on the worldwide web 10 October, 2021 at: https://www.nytimes.com/2021/08/19/style/brazillian-butt-lift-bbl-how-much-risks.html

6. Rios L, Gupta V. Improvement in Brazilian Butt Lift (BBL) Safety With the Current Recommendations from ASERF, ASAPS, and ISAPS. Aesthet Surg J. 2020; 40(8): 864-870. DOI 10.1093/asj/sjaa098.

7. EMSculpt "Brazilian Butt Lift" Accessed on worldwide web 10 October, 2021 at: https://newradianceemsculpt.com/target-areas/emsculpt-neo-buttocks-lift/

8. Lin MJ, Dubin DP, Khorsando H. Poly-L-Lactic Acid for Minimally Invasive Gluteal Augmentation. Dermatologic Surg. 2020; 46(3):386-394. DOI 10.1097/DSS.0000000000001967

9. Clark RF, Cantrell, FL, Pacal A, Chen W, Betten DP. Subcutaneous silicone injection leading to multi-system organ failure, Clin Toxicol. 2008; 46:9, 834-837 . December, 2008. DOI: 10.1080/15563650701850025

10. Peiser J. A mother and daughter gave a woman illegal buttocks injections, police say. Washington Post. Accessed on the worldwide web 10, October, 2021 at: https://www.washingtonpost.com/nation/2021/09/22/butt-lift-surgery-murder-charge/

11. Jennings R. The $5,000 Quest For the Perfect Butt. Vox. Accessed on the worldwide web 10 October, 2021 at: https://www.vox.com/the-goods/22598377/bbl-brazilian-butt-lift-miami-cost-tiktok

12. Chajchir A, Benzaquen I. Fat-Grafting Injection for Soft-Tissue Augmentation. Plast Reconstr Surg. 1989; 84(6): 921-934. (pre DOI) PMID: **2587656**

13. History of the Brazilian Butt Lift in Brooklyn – Dr Leonard Grossman. Accessed on the worldwide web on 10 October, 2021 at: https://www.youtube.com/watch?v=mY6xpzoF4EU

14. DelVecchio DA, Rohrich RJ. A Changing Paradigm: The Brazilian Butt Lift Is Neither Brazilian Nor a Lift—Why It Needs To Be Called Safe Subcutaneous Buttock Augmentation. Plast Reconstr Surg. 20320; 145(1): 281-283. DOI: 10.1097/PRS.0000000000006369

15. Del Vecchio DA, Rohrich RJ. A classification of clinical fat grafting: different problems, different solutions. Plast Reconstr Surg. 2012 130(3):511-522. DOI: 10.1097/PRS.0b013e31825dbf8a

16. Coleman SR. Fat Grafting to the Buttocks, Live Surgical Demonstration. The Aesthetic Meeting 2013 – ASAPS/ASERF Annual Meeting, New York, NY. April 11, 2013 - April 16, 2013.

17. Abd-Elfattah HM, Abdelazeim, F H, Elshennawy S. Physical and cognitive consequences of fatigue: A Review. J Adv Res. 2015; 6(3): 351–358. DOI: 10.1016/j.jare.2015.01.011

18. DelVecchio DA, Wall SJ. Expansion Vibration Lipofilling – A New Technique in Large Volume Fat Transplantation. Plast Reconstr Surg. 2018; 141(5):639e-649e. DOI: 10.1097/PRS.0000000000004338

19. Cansancao AL, Condé-Green A, Vidigal RA, Rodriguez RL, D'Amico RA. Real-Time Ultrasound-Assisted Gluteal Fat Grafting. Plast Reconstr Surg 2018; 142(2):372-376. DOI: 10.1097/PRS.0000000000004602

20. Grazer FM, De Jong RH. Fatal outcomes from liposuction: census survey of cosmetic surgeons. Plast Reconstr Surg 1990; 105(1): 436-46. DOI: 10.1097/00006534-200001000-00070

21. Wall SJr., Del Vecchio D, Teitlebaum S. et al. Subcutaneous Migration: A Dynamic Anatomical Study of Gluteal Fat Grafting. Plast Reconstr Surg. 2019; 143(5):1343-1351. DOI: 10.1097/PRS.0000000000005521

22. Cárdenas-Camarena L, Bayter JE, Aguirre-Serrano H, Cuenca-Pardo J. Deaths caused by gluteal lipoinjection: what are we doing wrong? Plast Reconstr Surg. 2015; 136(1):58-66. DOI: 10.1097/PRS.0000000000001364

23. Cárdenas-Camarena, L, Durán H, Robles-Cervantes J. et al. Critical Differences between Microscopic (MIFE) and Macroscopic (MAFE) Fat Embolism during Liposuction and Gluteal Lipoinjection. Plast Reconstr Surg. 2018; 141(4):880-890. DOI: 10.1097/PRS.0000000000004219

24. Nissar S. Emergency management of fat embolism syndrome. J Emerg Trauma Shock. 2009; 2(1): 29–33. DOI: 10.4103/0974-2700.44680

25. Del Vecchio DA, Villanueva, NL, Mohan R. et al. Clinical Implications of Gluteal Fat Migration: A Dynamic Anatomical Study. Plast Reconstr Surg. 2018; 142(5): 1180-1192. DOI: 10.1097/PRS.0000000000005020

26. Macias AA, Ramos-Gallardo,G. Durán H. Macro Fat Embolism After Gluteal Augmentation With Fat: First Survival Case Report. Aesthetic Surg Jour. 2019; 39(9): NP 380- NP 383. DOI: 10.1093/asj/sjz151

27. Wang NN, Panda N, Jeong S. et al. Cerebral Fat Embolism in a Trauma Patient with Captured Imaging of Echogenic Emboli in the Inferior Vena Cava. Journ Med Ultrasound. 2016; 24(1): 162-165. DOI:10.1016/j.jmu.2016.08.006

28. Dayan ,; Theodorou S, Del Vecchio D. Nanotechnology and Artificial Intelligence: A novel technique for patient assessment after Radiofrequency Assisted Liposuction and Gluteal Fat Transfer. Plast Reconstr Surg. 2022; Submitted for publication.

29. Brown S, Lipschitz A, Kenkel J. et al. Pharmacokinetics and safety of epinephrine use in liposuction. Plast Reconstr Surg. 2004; 114(3):756-63. DOI: 10.1097/01.prs.0000131021.17800.be

30. Del Vecchio D. Common Sense for the Common Good: Staying Subcutaneous during Fat Transplantation to the Gluteal Region. Plast Reconstr Surg. 12018; 42(1):286-288. □ □ DOI: 10.1097/PRS.0000000000004541

31. What is Awake Brazilian Butt Lift? Accessed on the worldwide web on 10 October, 2021 at: https://millardplasticsurgery.com/liposuction-info/awake-bbl/

32. Hyman MC, Vemulapalli S, Szeto WY. et al . Conscious Sedation Versus General Anesthesia for Transcatheter Aortic Valve Replacement: Insights from the National Cardiovascular Data Registry Society of Thoracic Surgeons/American College of Cardiology Transcatheter Valve Therapy. Circ. 2017; 136(22): 2132-2140. DOI: 10.1161/CIRCULATIONAHA.116.026656

33. Abram E, Francis M. Hazards of Sedation for Interventional Pain Procedures. Offic Journ Anesth Patient Safety Found Newsletter. 2012; 27(2): 29-44.

34. Chia CT, Theodorou SJ, Dayan E. et al. “Brazilian Butt Lift” under Local Anesthesia: A Novel Technique Addressing Safety Concerns. Plast Reconstr Surg. 2018; 142(6): 1468-1475. DOI: 10.1097/PRS.0000000000005067

35. Iverson RE, Lynch DJ. Practice Advisory on Liposuction. Plast Reconstr Surg. 2004; 113(5): 1478-90. DOI: 10.1097/01.prs.0000111591.62685.f8

36. Beidas OE, Gusenoff JA. Update on Liposuction: What All Plastic Surgeons Should Know. Plast Reconstr Surg. 12021; 47(4): 658-668. DOI: 10.1097/PRS.0000000000007419

37. Chow I, Alghoul MS, Khavanin N. et al. Is there a safe lipoaspirate volume? A risk assessment model of liposuction volume as a function of body mass index. Plast Reconstr Surg. 2015; 136(3): 474-483. DOI: 10.1097/PRS.0000000000001498

38. Gladwell M. *Outliers*. Boston, USA: Little, Brown & Company; 2008.

39. How Much is a Brazilian Butt Lift in New York? Accessed on the worldwide web 10 October, 2021 at: https://www.google.com/search?client=firefox-b-1-d&q=how+much+is+a+BBL+in+New+York+City

40. How Much is Brazilian Butt Lift in Miami? Accessed on the worldwide web 10 October, 2021 at: https://www.google.com/search?q=how+much+is+a+BBL+in+Miami&client=firefox-b-1-d&sxsrf=AOaemvLWMjelsB_oWAUCqJYMo4ougUWFJA%3A1635345300597&ei=lGN5YdTfI7moqtsPwNmZeA&ved=0ahUKEwjU-ef95-rzAhU5lGoFHcBsBg8Q4dUDCA0&uact=5&oq=how+much+is+a+BBL+in+Miami&gs_lcp=Cgdnd3Mtd2l6EAMyBQgAEIAEMgYIABAWEB4yBggAEBYQHjIGCAAQFhAeMgYIABAWEB4yBggAEBYQHjIGCAAQFhAeMgYIABAWEB4yBggAEBYQHjIGCAAQFhAeOgcIABBHELADSgQIQRgAUMC0AlimvAJgy84CaAFwAngAgAGGBogB8hySAQM2LTWYAQCgAQHIAQjAAQE&sclient=gws-wiz

41. Denson JL, McCarthy M, Fang Y, Evans L. Increased Mortality Rates During Resident Handoff Periods and the Effect of ACGME Duty Hour Regulations. Am J Med. 2015; 128(9):994-1000. DOI: 10.1016/j.amjmed.2015.03.023

42. Kato H, Jena AB, Tsugawa Y. Patient mortality after surgery on the surgeon’s birthday: observational study. Brit Med Journ. 2020; 371(4381). DOI: 10.1136/bmj.m4381

43. Aylin P, Alexandrescu R, Jen M, Mayer E, Bottle A. Day of week of procedure and 30 day mortality for elective surgery: retrospective analysis of hospital episode statistics. British Med Journal. 2013; 346(2424). DOI: 10.1136/bmj.f2424

44. Neal DJ. Fatal Brazilian butt lift was day’s 7th illegal surgery by Coral Gables doctor. Miami Herald. 2021. Accessed on worldwide web 27 November, 2021 at:

https://www.miamiherald.com/news/health-care/article256016237.html

45. U.S. Department of Transportation, National Highway Traffic Safety Administration. Accessed on worldwide web on 10 October, 2021 at: https://www.iii.org/fact-statistic/facts-statistics-distracted-driving

46. Federal Motor Carrier Safety Administration: Hours of Service Limitations Guidelines. Accessed on worldwide web, 10 October, 2021 at: https://www.fmcsa.dot.gov/regulations/hours-of-service

Figure Legend

Figure 1. An operator using the syringe method of large volume fat transplantation in a 34-year-old female patient uses thenar muscles to initiate fat flow, elbow, and shoulder muscles to generate an axial "to and fro" motion through the recipient site, and finally proprioception to "feel" where the tip of the cannula is. The resultant fatigue decreases proprioception and accuracy of cannula location.

Figure 2. Sketch showing surgeon with both thumbs on plunger of 60 cc syringe.

Figure 3. Three panel depiction of Pazmino's technique for ULTRA BBL. (A) Pretreatment ultrasound shows dermis, (B) superficial subcutaneous fascia, and (C) gluteus muscle fascia. The superficial subcutaneous fat lies between the dermis and the superficial subcutaneous fascia; the deep subcutaneous fat lies between the superficial subcutaneous fascia and the gluteus muscle fascia. After insertion of a 4 mm basket cannula, the correct position of the device is seen in the deep subcutaneous fat layer. After lipo filling using a roller pump and vibrational insertion and keeping both the ultrasound probe and the cannula immobile, fat migration is visible in the deep subcutaneous layer, with marked thickening of this layer and downward depression of the gluteus fascia. (Images courtesy of Pat Pazmino, MD.)

Figure 4. BBL fatalities from PFE and day of the week. Source, Florida Board of Medicine.

Table 1. Guidelines Summary

Summary of recommendations	
Ensuring correct anatomic placement	
1	Restrict fat placement to the subcutaneous plane
2	For graft volume > 200cc, use roller pump techniques
3	For graft volume > 200cc, avoid Luer syringe techniques
4	When using syringes never use 2-thenar technique to propel fat
5	Use cannulas 4mm or greater to insert fat
6	Ultrasound-guided BBL should be learned and incorporated into every gluteal fat grafting procedure; static injection technique is recommended
Eliminating distraction and fatigue	
7	Factors that cause distraction must be minimized during fat transplantation
8	Factors that cause operator fatigue must be minimized during fat transplantation
9	A "single surgeon" approach, where one performs the entire surgery, is recommended
10	A total of 3 BBL procedures is a reasonable limit of total procedures per day

Note the recommendation regarding ultrasound and the limits on BBL cases, as they are new and important guidelines.

Figure 1

Figure 2

Figure 3A

Figure 3B

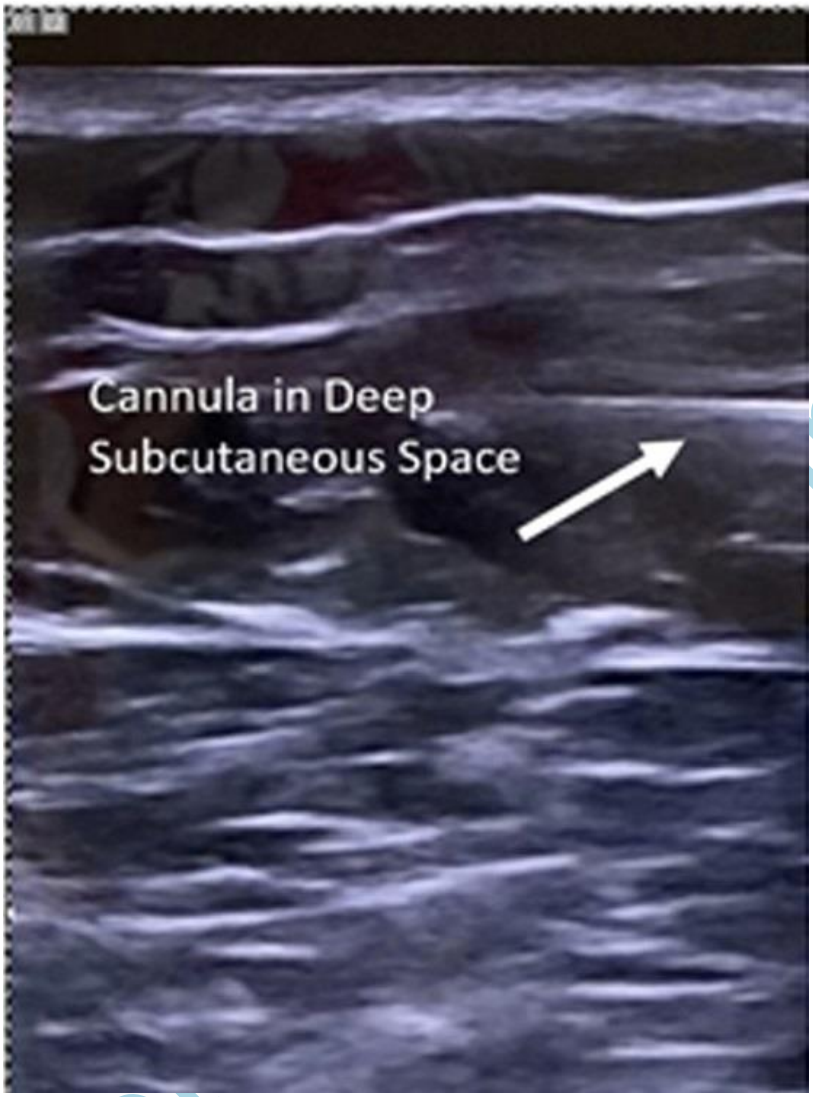

Figure 3C

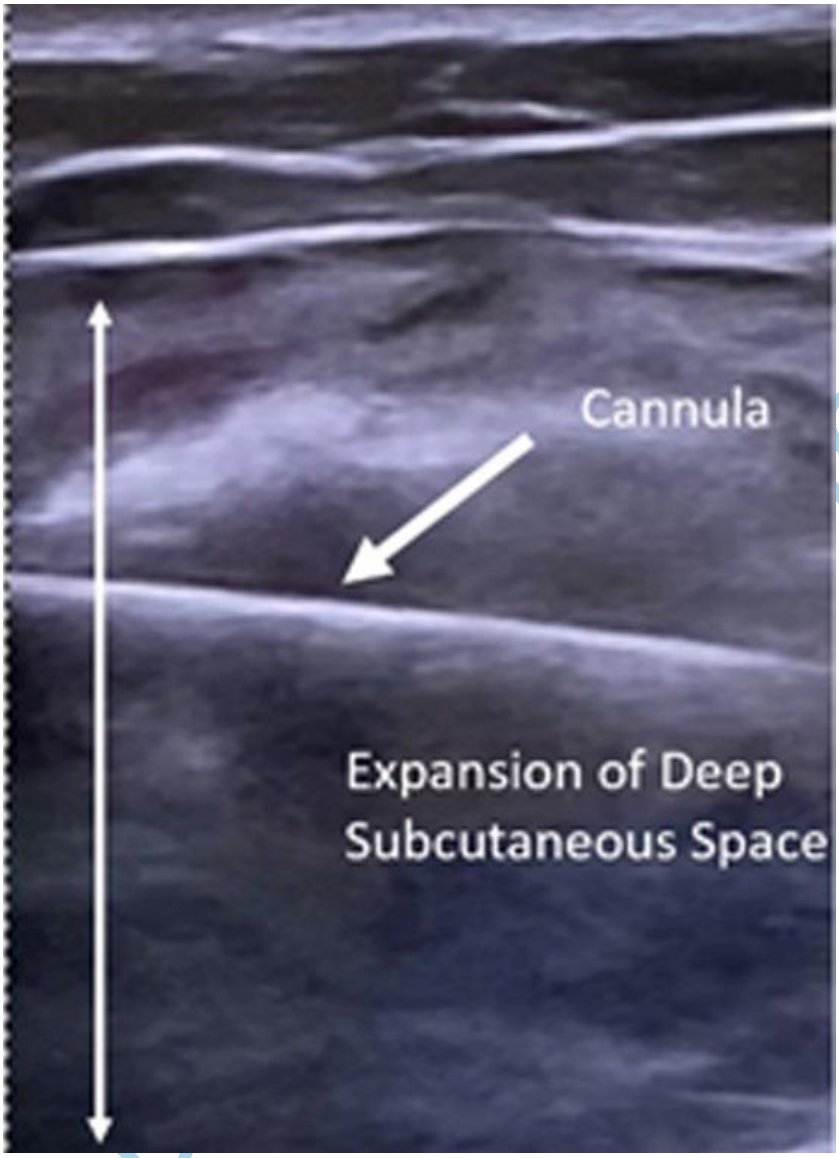

Figure 4