

Gluteal Augmentation With Fat: Retrospective Safety Study and Literature Review

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Aesthetic Surgery Journal
2019, Vol 39(3) 292–305
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journals.permissions@oup.com
DOI: 10.1093/asj/sjy153
www.aestheticsurgeryjournal.com

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Abstract

Background: Use of gluteal augmentation with fat increased by 3267% from 2002 to 2015, and the rate of death is highest compared with other aesthetic procedures: 1 in 3448 patients dies, compared with 1 in 55,000.

Objectives: To retrospectively investigate patients who underwent this procedure at Oslo Plastic Surgery Clinic, to review international data to determine factors causing mortality, and to provide guidelines for safety.

Methods: Patient data were searched for reason for the procedure, assessment of patients, techniques performed, and safety measures used. In 60 cases, a vibration machine was used for fat harvesting. Review of the international literature, with special emphasis on fatal complications, was performed on Medline, Google Scholar, and PubMed.

Results: Mean patient age was 32 years. Mean amount of grafted fat was 422 mL (range, 210–850 mL). Sedation, local and tumescent anesthesia were used in all patients, with mobilization directly after surgery. Mean operation time was 89 minutes. Eighteen patients required a second surgery. Minor complications occurred in 8 patients. Average follow-up was 8 months. Ninety percent of patients were satisfied. Review of international literature showed that the main reason for death in 2015 was fat lung embolism related to muscular and submuscular grafting.

Conclusions: Gluteal augmentation with fat is one of the most popular procedures, with an internationally high mortality rate. Patient safety is a priority, and preventive measures should improve safety because appropriate patient selection, avoiding muscular and submuscular grafting, avoiding infragluteal incision, moderate grafted volume, and direct postoperative mobilization are essential.

Level of Evidence: 4

Editorial Decision date: May 25, 2018; online publish-ahead-of-print June 20, 2018.



The Brazilian butt lift (BBL), the popular name of gluteal augmentation, was first introduced by Toledo in the 1980s and 1990s^{1–5} and later performed by others.^{6–8} Use of the gluteal fat grafting technique increased by more than 280% from 2011 to 2015^{9–11} and by 3267% from 2002 to 2015.¹² Buttocks augmentation is now one of the fastest-growing aesthetic procedures in the United States.¹³ According to the American Society for Aesthetic Plastic Surgery (ASAPS), more than 20,000 procedures were performed in 2016.¹² This popularity has led to a greater focus in the media, which has concentrated on the complications associated with gluteal augmentation using fat. Compared with the rate of death after other aesthetic procedures, which is estimated to be 1

in 55,000,⁹ gluteal fat grafting has an alarming rate of 1 in 3448.¹⁰ The risk for complications has stimulated research

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and publication of articles on this topic. Inflammatory news reports are almost a daily occurrence in the media.

This retrospective study was conducted to evaluate patients who underwent this procedure at the Oslo Plastic Surgery Clinic, Oslo, Norway, since 2014; to review international data to determine what factors might be causing the high mortality rate; and to provide guidelines to help eliminate or drastically reduce the death rate.

METHODS

Study Design

This retrospective study was conducted using consecutive patient medical records from the Oslo Plastic Surgery Clinic. A total of 44 patients who underwent gluteal augmentation using fat grafting at Oslo Plastic Surgery Clinic between December 2014 and October 2017 were included in the study. The study was conducted in accordance with the guiding principles of the Declaration of Helsinki.

Subjects

Eligible patients had to have been followed up for at least 3 months and have available medical records and photographs. The 44 patients, all women, underwent a total of 63 procedures, including second and third surgeries. Patient data were searched to extract reason for the procedure, assessment of the patients, techniques performed, and safety measures used.

Mean patient age at the time of operation was 32 years (range, 19-53 years) (Table 1). Body mass index (BMI) was within the normal range for 38 patients and was higher than normal in 6 patients (<30 mg/kg²). Twenty-six patients had previously undergone plastic surgery. Reasons for augmentation were flat buttocks in 18 cases, congenital asymmetry in 3, congenital atrophy in 1, body contouring in 3, increasing gluteal volume in 19, and a combination of these in 6. Three patients underwent the procedure in combination with other procedures, such as breast augmentation with fat grafting (Table 2).

Preoperative Assessment

Evaluation included a full clinical examination, especially regarding BMI, which should be less than 30 kg/m². Patient weight should be adjusted before surgery, and weight should be stable for at least 6 months. Optimally, the patient should have an American Society of Anesthesiologists (ASA) score of 1 or 2. In our clinic, we map diseases for which the patient scores a 3 or 4. Anticoagulants are seldom an issue in patients who score 1 or 2 on the ASA; however, in rare cases, this requires individual assessment of indication and type of drug.

Table 1. Age Distribution of Patients

Age range, years	No. of patients (%)
18-20	2 (4.5%)
21-25	10 (23%)
26-30	11 (25%)
31-35	9 (20.5%)
36-40	4 (9%)
41-45	3 (7%)
>45	5 (11%)

Table 2. Reasons for Procedure

	No. of patients (%)
Wanting larger volume	19 (43%)
Flat buttocks	18 (41%)
Combination	6 (14%)
Congenital asymmetry	3 (7%)
Figure forming	3 (7%)
Congenital atrophy	1 (2%)

On the day of consultation, patient expectation is addressed. Areas to reshape or augment, or both, are discussed (eg, shaping the buttocks or gluteal area, augmenting these areas, or both). Using a mirror, the patient decides where the fat should be harvested from. It is important to avoid “fat hunting,” or taking of fat from areas the patient has no need to correct because this could lead to unfavorable aesthetic effects in the donor area. Generally, patients complain about the abdomen; the sides and hip areas; the lower extremities, including the outer and inner thigh; and the inner knee.

A demonstration in the consultation room is made by drawing directly on the gluteal area of the patient, which will be divided into 4 quadrants: the upper left, upper right, lower left, and lower right. The fifth area that most patients want augmented is the lateral area at the continuation of the waist area toward the outer side of the thigh, most often because the skin has depressions. Incision lines are also shown to the patient. The anatomic shape and elasticity of the gluteal area, the patient’s desire to enlarge, and the available fat in the donor sites help to determine the graft amount. An estimation of the limits of the procedure (what it can realistically achieve) is discussed with the patient before the operation (Figure 1). Two-dimensional images are created to illustrate the potential outcome; however, to keep patient expectations realistic, it is emphasized that this is only a simulation.

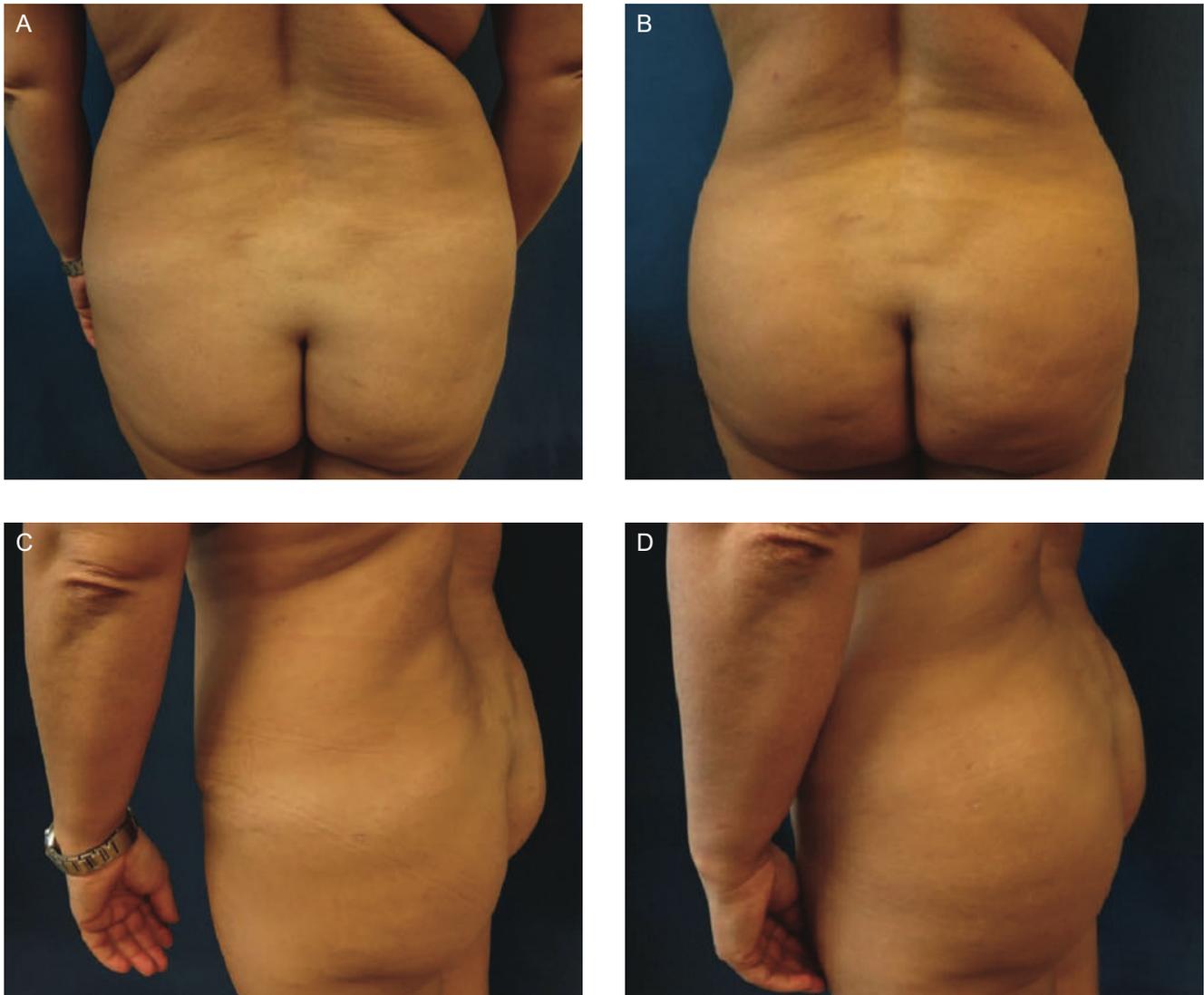


Figure 1. A 43-year-old woman with flat buttocks seeking gluteal augmentation preoperatively, (A) posterior and (C) lateral views. (B) Posterior and (D) lateral views 12 months after grafting 540 mL bilateral (total 1080 mL) and lateral view using MicroAire®.

Showing patients previous patient results is helpful: at least 5 different results and different indications to give the patient realistic expectations. Patient reaction to the images provides clues regarding the patient's motivation. The patient also often brings photographs from magazines to show desired results.

Expected consultation time is 30-40 minutes, not including the time necessary to fill out the patient information forms. Prescriptions for antibiotic and painkillers are written at the time the patient is scheduled to undergo surgery. A cooling-off period of at least 2 weeks before the procedure is important. It is also important to ask the patient how long he or she has been thinking about going through with the surgery to make sure it is not an impulse decision.

For patients who must travel longer distances to the clinic, a thorough consultation is conducted by video conference; health records and photographs are sent before this meeting. The assessment is the same as if the patients were in the clinic. Patients come 1 day before the scheduled operation for a thorough live consultation to make final decisions about the operation for the next day.

Anesthesia Assessment

The patient is sedated using monitored anesthesia care (MAC) until a level of moderate or deep sedation is reached per the ASA classification.¹⁴ A Midazolam and Fentanyl intravenous bolus, combined with a Propofol infusion are used while the patient is spontaneously breathing and

receiving supplemental oxygen. The patient is monitored by electrocardiography, oxygen saturation, blood pressure, and capnography. This approach relies on use of a good local anesthetic. The Oslo Clinic uses tumescent lidocaine composed of 800 mg lidocaine and 1 mg epinephrine in 1000 mL saline (NaCl 0.9%). Tumescent lidocaine anesthesia is considered safe at doses of 28 mg/kg without liposuction and 45 mg/kg with liposuction.¹⁵ The tumescent is warmed to 38°C to 40°C to avoid hypothermia and for the comfort of the patients.¹⁶

Operation Day

Preoperative Period

Premedication is given by the anesthesiologists and then the patient meets with the surgeon. A permanent marking is done to show where the fat will be taken from and where it will be transplanted (Figures 1 and 2). If there is a difference from what was agreed on during the consultation, whether augmentation or reshaping, the surgeon will reevaluate. New photos will be taken, and the patient will then be brought to the operating room. The temperature should be 22°C to 23°C to prevent hypothermia. If the donor area includes the abdomen, the patient must lie supine. Unless there is an indication to use perioperative leg garments, such as with obese immobilized patients, they are not used.

Intraoperative Period

Preparation and draping of the patient is important to avoid compromising sterility when turning the patient. The amount of lipotumescent equals the expected amount of fat extraction. After inducing sedation in a sterile environment, lipotumescent is injected into the donor areas. After 15 minutes, harvesting of the fat is started. This allows for equalized pressure on the fat and prevents unwanted irregularities if only 1 or 2 holes are made.

Positioning

After positioning for lipoaspiration, possibly supine position if taking fat from the abdomen, the patient is placed in a prone position when gluteal augmentation is to be performed. While placing patients in this position, avoid bending the patient's knees to avoid lower extremity venous stasis, which increases the risk for deep venous thrombosis. This prone position allows for greater control and safety, with use of the grafting cannulas from supragluteal and lateral incisions into more of a subcutaneous plane. Straight cannulas are used to better control the direction of the grafting.

Harvesting and Processing the Fat

The fat is extracted in a closed system into a canister of 0.5, 1, or 2 liters, depending on the amount planned for

extraction. The operation should be efficient and performed in the shortest possible time to ensure the best quality of fat, to reduce the time of exposure of the patient, and lessen the possibility of complications. It is unnecessary to wait for the local anesthetics to be effective because they usually have already taken effect in the first area by the time injection in the last area is finished. The MicroAire system is used for harvesting fat. While switching off the pressure from the canister, the incision of the donor sites is sutured with 5.0 polyglactin 910 and additional tape. During that time, decanting of the fat is done in 10 minutes to separate blood from fat. If the patient must be turned over to a prone position, this is also done now. The anesthesiologist lightens the total intravenous anesthesia so the patient wakes up and can help with changing of position. Local anesthetic is always applied to the incision line and a 1- to 2-mm incision is made with a No. 11 blade.

About 50 mL of lipotumescent is infiltrated with low pressure to the gluteal areas to prepare the recipient sites. When the connection is tight between the skin and the underlying layers, a vibration cannula is used. Supragluteal and upper lateral incisions are used. When the Oslo Clinic first started performing this procedure, an infragluteal incision was used; however, with the risk correlated with this placement, this entry incision has been discontinued and only supragluteal and lateral incisions are used because they are safer. Furthermore, an internates incision is not used because of the low hygiene quality in this region. Subgluteal incisions are also no longer used at the Oslo Clinic because it is easy for the cannula to be tilted back to the greater sciatic foramen. Upper and lateral incisions are used, 2 or 3 per side.

Reshaping is done on one side and one area at a time and then compared with the other side so the shaping is complete before beginning augmentation. The grafting should be stopped when the skin changes color to white or if the fat overruns the injection sites. In most cases, grafting is avoided from the lower part of the buttocks because the patient seldom asks for this and, by putting more fat in that area, more skin will hang postoperatively. Patients usually want to augment the upper part and fill the depression laterally.

A 4-mm or 5-mm cannula is used for harvesting, with 3 holes equally distributed around the diameter to equalize the pressure on the donor site. Grafting level is always subcutaneous and suprafascial; there is no muscular or submuscular grafting. The grafting cannula is a 3-mm blunt 1-hole cannula at the tip; the opening goes in the transfer direction, with a diameter to equalize the distribution of the grafted fat. The Oslo Clinic started to use a 4-mm cannula after recommended guidelines in 2017 to enhance the safety of the procedure.

The anesthesiologist notes the anatomic position and amount (in milliliters) of fat injected on a sheath; a syringe



Figure 2. A 24-year-old woman with flat buttocks seeking gluteal augmentation preoperatively, (A) posterior and (C) lateral views. (B) Posterior and (D) lateral views 12 months after grafting 500 mL per side mostly in the upper and lateral part (total 1000 mL) using MicroAire®. (E) Preoperative planning where the donor sites and grafting directions are marked.

of 50 mL at a time is grafted. Hydrogen peroxide is applied to all incision lines, followed by 5.0 or 6-0 polyglactin 910 sutures and tape.

Postoperative Period

A pressure garment is applied to the patient while he or she is on the operating table, and pressure on the fat is reduced by making a window in the garment over the gluteal area. The patient is awoken by discontinuing anesthesia and then helped to the recovery room, where he or she will lie in the prone position. Patients stay between 1 and 2 hours to make sure they are totally awake and have been eating and drinking. An adult always accompanies the patient and must be with the patient the first 24 hours. The patient is encouraged to walk around from day 1 to reduce any mobility problems. An antibiotic (cephalexin) is given for 3 days, starting from the day before surgery. Follow-up is always the day after surgery. Patients must not fly for at least 2 days (short flight less than 2 hours) to 1 week (long flight, more than 2 hours). Follow-up periods are at 2 weeks, 3 months, 6 months, and 1 year. If the result is not satisfactory, a second operation is performed. This subsequent procedure might have been planned in advance because of tightness of skin and/or lack of fat. The Oslo Plastic Surgery Clinic has a 1-year guarantee of satisfaction or additional surgery is free of charge, so patients can ask for new augmentation or correction. This can contribute to reliable results. Figures 1 and 2 show examples of average results with varied follow-up and indications after augmentation using fat.

Review of International Literature

Medline, Google Scholar, and PubMed searches were performed, with special emphasis on recent literature regarding fatal complications, which started to appear in 2015. All relevant literature that focused on complications, especially mortality, was searched. No exclusion criteria were defined because the information on mortality is crucial even if statistically it was not possible to be included in a comparison with other studies as in Cárdenas-Camarena et al mortality reports,¹⁷ which were not included in the meta-analyses of Conde-Green.¹⁸

RESULTS

Retrospective Study

Average age at the time of operation was 32 years (range, 19-51 years) (Table 1). Thirty-eight patients had a normal BMI, and 6 patients had a higher BMI (< 30 mg/kg²). Reasons for the first procedure were flat buttocks in 18 patients, congenital asymmetry in 3 patients, congenital

atrophy in 1 patient, figure forming in 3 patients, and increase of volume in 19 patients. Six patients had a combination of these reasons. For the 18 patients undergoing a second procedure, reasons were a desire for larger gluteal volume in 12 patients and correction of asymmetry in 6 patients. In 60 cases, MicroAire was used for harvesting, whereas the Nouvag Vacuson 60 LP liposuction system was used in 2 cases, and a manual syringe was used in 1 case. Patients were mobilized directly after surgery.

Mean operation time was 89 minutes for the first surgery (range, 55-150 minutes) and 57 minutes for the subsequent operation (range, 40-109 minutes) (Table 3). The mean amount of grafted fat in the first session per side was 422 mL on the right and 419 mL on the left. The most grafted fat in the first session was 850 mL, and the least was 210 mL. In the second surgery, the mean amount of fat grafted per side was 153 mL on the right side and 137 mL on the left side, ranging from 50 to 285 mL (Table 3). In the third surgery, 100 mL of fat were grafted per side. Only 1 patient underwent a third procedure. The second surgery used less mean volume for several reasons. The request for enlargements was mainly met after the first session, and only small adjustments in certain areas were further required. In addition, in some patients, there was not enough residual fat to harvest the second time. Eight (around 13% of all procedures) patients (all 63 procedures included) experienced minor complications: 3 felt nausea and dizziness, 2 had a reaction to anesthesia, 2 had swelling and bruises, and 1 required urinary catheterization. Complications were treated successfully (Table 4).

Sedation in combination with local anesthesia was used in all 44 patients; local anesthesia by itself was not used. Average follow-up was 8 months for the first surgery (range, 3-18 months) and 5 months for the second surgery (range, 3-11 months). Assessment of satisfaction included only the patients who were followed up for 6 months or more. Ninety percent of patients were satisfied with the results (Figures 1 and 2).

Reported Complications in the International Literature

In a meta-analysis performed by Condé-Green et al,¹⁸ the authors analyzed the published techniques of gluteal fat augmentation and identified those of potential concern. Their results after studying 17 case series and 2 retrospective studies, which included 4105 patients from Colombia, Mexico, and Brazil who had a mean of 400 mL decanted lipoaspirate injected into each gluteal region, showed that most patients were very satisfied with their results. With a 7% mean complication rate, the results showed no significant correlation to the planes of injection. Condé-Green et al concluded that fat grafting was an "effective and

Table 3. Mean Operation Time (in Minutes) and Mean Amount of Fat Grafted (in Milliliters)

	First session	Second session
Mean operation time, minutes	89 (range, 55-150)	57 (range, 40-109)
Mean fat grafted, mL, left side	419 (range, 210-850)	137 (range, 50-285)
Mean fat grafted, mL, right side	422 (range, 210-850)	153 (range, 50-285)

Table 4. Complications After Gluteal Augmentation with Fat

Complication(s)	No. of patients (%)
Nausea and dizziness	3 (5%)
Reaction to anesthetics	2 (3.2%)
Minor swelling and bruises	2 (3.2%)
Urinary retention	1 (1.6%)
Skin necrosis/compartment syndrome	0 (0%)
Pulmonary embolism	0 (0%)

predictable way to remodel gluteal regions,” but agreed that the procedure had risks that could be avoided by preventing fat embolism by avoiding gluteal vessel damage. They stated that analysis and systemization of the procedure and reporting of cases in the fat grafting registry would aid in optimization of outcomes.

Oranges et al¹⁹ published a comprehensive literature review on the techniques of gluteal augmentation in 2017. The aim was to study the overall complications and satisfaction rates associated with the broad spectrum of techniques. They used *a priori* criteria to review clinical studies involving gluteal augmentation techniques from a search of PubMed/Medline. They found 52 studies, representing 7834 treated patients, and found 5 gluteal augmentation techniques were used: gluteal augmentation with implants (n = 4781), autologous fat grafting (n = 2609), local flaps (n = 259), hyaluronic acid gel injection (n = 69), and local tissue rearrangement (n = 6). Their results showed that the overall complication rates were 30.5% for gluteal augmentation with implants, 10.5% for autologous fat grafting, 22% for local flaps, and 39.1% for hyaluronic acid gel injections. A high satisfaction rate was reported for all 5 techniques. Autologous fat grafting had the lowest complication rates but included serious major complications, such as 4 cases of fat embolism and 1 death, which was related to fat embolism.

In 2016, Sinno et al published an article²⁰ for which the authors searched through the PubMed, Medline, and Cochrane databases in April 2015 for studies that achieved buttocks augmentation using silicone implant placement or autologous lipoinjection. Complication outcomes of interest included wound dehiscence, infection, seroma,

hematoma, asymmetry, and capsular contracture. Forty-four articles met inclusion criteria. The most commonly reported complications in 2375 patients who received silicone implants were wound dehiscence (9.6%), seroma (4.6%), infection (1.9%), and transient sciatic paresthesia (1.0%), with an overall complication rate of 21.6% (n = 512). The most commonly reported complications in 3567 patients receiving autologous fat injection were seroma (3.5%), undercorrection (2.2%), infection (2.0%), and pain or sciatalgia (1.7%), with an overall complication rate of 9.9% (n = 353). Patient satisfaction after surgery was assessed differently among studies and could not be compared quantitatively. Sinno et al²⁰ concluded that, although gluteal augmentation was once reported to have complication rates as high as 38.1%, a systematic review of the 2 most popular techniques showed substantially lower overall complication rates. The overall complication rate with autologous fat grafting (9.9%) was lower than that with silicone buttocks implants (21.6%). Sinno et al stated that a standardized method of measuring patient satisfaction was necessary to fully understand outcomes of these increasingly popular procedures.

Alarming data were found in an article by Cárdenas-Camarena et al,¹⁷ published 1 year previously (not included in the previous meta-analyses because of statistical issues). Cárdenas-Camarena et al made an analysis of secondary deaths from gluteal augmentation procedures performed in Mexico and Colombia over a period of 10 and 15 years, respectively. In Mexico, the study was performed through a survey of all members of the Mexican Association of Reconstructive, Plastic, and Aesthetic Surgery. In Colombia, the study was performed through an analysis of deaths and autopsies documented by the National Institute of Legal Medicine and Forensic Sciences Regional Bogotá. The results showed that 413 Mexican plastic surgeons reported 64 deaths related to liposuction, with 13 deaths caused by gluteal lipoinjection. In Colombia, 9 deaths were documented. Of the 13 deaths caused by gluteal lipoinjection in Mexico, 8 (61.6%) occurred during lipoinjection, whereas the other 5 (38.4%) occurred within the first 24 hours after lipoinjection. In Colombia, 6 deaths (77.7%) occurred during surgery and 3 occurred (22.2%) immediately after surgery. In the Colombian autopsy results, 7 cases of macroscopic fat embolism and 2 cases of microscopic embolism were reported, with abundant fatty tissue in the infiltrated gluteal muscles. In the study by Cárdenas-Camarena et al, the authors found that intramuscular gluteal lipoinjection was associated with death caused by gluteal blood vessel damage, allowing macroscopic and microscopic fat embolism; therefore, buttocks lipoinjection should be performed very carefully, avoiding injection into deep muscle planes.

In autumn 2016, more alarming reports of rates of death came from the Aesthetic Surgery Education and Research

Foundation (ASERF) Task Force, followed by a published article in March 2017 by Mofid et al.⁹ Mofid et al sent an anonymous web-based survey to 4843 plastic surgeons worldwide, with the aim of determining the incidence of fatal and nonfatal pulmonary fat embolism associated with gluteal fat grafting and providing recommendations to decrease the risks associated with the procedure. Additional data on morbidity and mortality were collected through confidential interviews with plastic surgeons and medical examiners, public record requests for autopsy reports in the United States, and the American Association for the Accreditation of Ambulatory Surgical Facilities (AAAASF). Results were as follows: 692 surgeons who responded to the survey reported 198,857 cases of gluteal fat grafting. Over their careers, surgeons reported 32 deaths from pulmonary fat emboli and 103 nonfatal pulmonary fat emboli. Three percent (3%) of respondents experienced a patient death and 7% of respondents reported at least 1 pulmonary fat embolism in a patient over their careers. Surgeons reporting the practice of injecting into the deep muscle experienced a significantly increased incidence rate of fatal and nonfatal pulmonary fat emboli. Twenty-five deaths were confirmed in the United States over the past 5 years through autopsy reports and interviews with surgeons and medical examiners. Four deaths were reported from 2014 to 2015 from pulmonary fat emboli in AAAASF facilities. Mofid et al⁹ concluded that, despite the growing popularity of gluteal fat grafting, significantly higher mortality rates than with any other aesthetic surgical procedure seemed to be associated with gluteal fat grafting. Based on this survey, fat injections into the deep muscle, use of a cannula smaller than 4 mm, and pointing of the injection cannula downward should be avoided. They also added that more research is necessary to increase the safety of this procedure.

In November 2017, it was stated again that buttocks augmentation is one of the fastest growing aesthetic procedures in the United States. According to ASAPS, more than 20,000 procedures were performed in 2016 alone, (a 3267% increase over 2002, when ASAPS first began tracking statistics for buttocks augmentation).¹² ASAPS began tracking fat grafting to the buttocks in 2015, and for 2 years it collected those data: an average of 91% of all buttocks augmentation procedures have consisted of fat grafting. Recently, ASERF formed the Gluteal Fat Grafting Task Force to investigate the risks associated with this increasingly popular procedure. The task force comprised board-certified plastic surgeons and identified factors that either added risk or proved to be protective and/or preventative. These findings¹² were published in the *Aesthetic Surgery Journal* and have led to the adoption of the certain recommendations, such as avoiding injecting fat into the deep muscle, use of a equal or >4 mm single-hole injection cannula, avoiding downward angulation of the cannula, positioning of patient, and placing incisions to

create a path that will avoid deep muscle injections. They recommend additionally to maintain constant 3-dimensional awareness of the cannula tip, injecting with the tip always in motion, reviewing gluteal vascular anatomy and drawing landmarks to identify and avoid injection into the pedicle, considering pulmonary fat embolism in unstable intraoperative and postoperative patients, and including risk for fat embolism and surgical alternatives in the informed consent process.

An additional example of a study with a focus on complications and death after liposuction procedures is by Vongpaisarnsin et al.²¹ Their research mainly focused on death after cosmetic liposuction and gluteal augmentation caused by septicemia with *Pseudomonas aeruginosa*. In addition, they made a summary of the most common complication types.

As recently as January 2018, after reports of 3 deaths in Florida alone, the task force issued a safety advisory on gluteal fat grafting. It offered suggestions such as staying away from gluteal veins and the sciatic nerve, grafting fat from superficial planes only (subcutaneous as safest), concentrating the cannula tip throughout every stroke to ensure no deeper pass, avoiding deep angulation, using instruments that offer control of the cannula, and injecting only while the cannula is in motion to avoid high-pressure bolus injection.^{9,22-24}

DISCUSSION

The aim of this retrospective study was to investigate patients who underwent gluteal augmentation using fat at the Oslo Plastic Surgery Clinic, but also to review international data within this field. We are aware of the short follow-up time, and we could have waited for late results. However, the concerns here were for safety and surviving the procedure, with only minor complications or no complications. Although our study represents a small sample of patients, in our opinion, this number (63 cases) is adequate for basing observation and provides sufficient power.

In 2017, Nahai²⁴ articulated the hurdles and challenges when dealing with the high rate of death. He stated, "While I will exercise my very best surgical judgment based on the latest available information, my experience with this procedure is no guarantee that serious complications or death cannot occur." We should never place ourselves or our patients at risk. The risk is well known now and occurs with muscular and submuscular grafting, large-volume grafting, poor patient selection, and deficiency in perioperative technique. It is our responsibility to stay in the safe zone, not on the borderline.

Although the procedure has been done for many years, since the 1980s and 1990s, it first became popular at the start of this century, from 2000 to 2010. The biggest breakthrough came after 2011 and is still occurring. The first

alarming information came in 2015, with reports of a high rate of death. However, although many meta-analysis studies were performed in 2015 and 2016, no alarm was raised in the plastic surgery community until the work of ASERF and publication thereafter in 2017. During those years, stigma was associated with this procedure, and, although there are no statistically credible data, the complications continued. A network is needed to check all reports of fatalities and severe complications in aesthetic procedures and to alert the medical community in time, to ensure that the reputation of plastic surgery is intact and, even more important, that patients are safer. There are many ways to establish this network, and it is up to the main aesthetic and plastic surgery organizations to begin the process. The work of ASERF is an excellent starting point.

Patient Safety in Gluteal Fat Augmentation

Anatomy

The key to performing gluteal augmentation safely and minimizing risk and complications is to truly know the anatomy of the gluteal area (Figure 3). The greater sciatic foramen is especially important. The foramen is formed by the sacrotuberous and sacrospinous ligaments and the greater sciatic notch of the hip bone. This structure provides an exit from the pelvis into the gluteal region for numerous crucial anatomic structures, such as the piriformis muscle and several nerves, such as the sciatic nerve, the posterior cutaneous nerve of the thigh, the superior and inferior gluteal nerves, the nerves to the obturator internus and quadratus femoris, and the pudendal nerve (Figure 3).^{25,26}

It is essential to also keep in mind the vessels that run through this area. Both the superior and the inferior gluteal vessels and the internal pudendal vessel can be exposed to trauma and great damage if they are not handled with care and caution (Figure 3). It is crucial not to injure any structures while grafting fat. This could easily happen when the cannula is tilted posteriorly while using the infragluteal incision or when grafting deep to the muscle or under the muscle (Figures 4-6).²⁶

Literature

Review of the latest international literature has shown that, even in 2017, gluteal augmentation had a higher mortality rate than any other aesthetic surgery.¹⁰ The high international mortality rate seen could be a result of technique-related adverse effects after muscle and submuscular grafting, such as complications from blood vessel injection (eg, pulmonary embolism and bleeding); infection (eg, necrotizing fasciitis); anesthesia-related causes; and patient-related causes (eg, systemic failure and being a poor candidate). The death related to thromboembolism, shown by existing meta-analyses about gluteal

augmentation with fat, varies: 5 emboli were reported in 4105 patients (0.12%),¹⁸ 4 fat emboli and 1 death were reported in 2609 patients (0.2%),¹⁹ and 26 fatal fat emboli were reported with fat grafting to the gluteal area, with a total 64 deaths related to liposuction.¹⁷ One-hundred-three nonfatal and 32 fatal pulmonary embolisms were reported in 198,857 operations performed by 692 surgeons (0.02% mortality rate).⁹ In 2017, Ramos-Gallaro et al illustrated an anatomic study of prevention of fat embolism in fat grafting for gluteal augmentation.²⁶

Positioning

In 2018, Villanueva et al²³ recommended putting the patient in a prone position with hips flexed in a “jack-knife” position. However, as they stated, while placing patients in this position, attention must be directed to also bending the knees to avoid lower extremity venous stasis, which increases the risk for deep venous thrombosis. Furthermore, in our view, the cannula inserted from infragluteal and supragluteal incisions in this position could be easily tilted downward to the greater sciatic foramen area. Therefore, we do not recommend use of an angled cannula in this region. We agree that, for lateral positioning, as Mendieta⁶ reported previously, this technique can guide the procedure to a more superficial grafting plane.

No major complications occurred in patients at the Oslo Clinic because of the guidelines applied, such as use of a blunt cannula, staying superficial, avoiding insertion from the lower buttocks, and thinking about the location of the greater sciatic foramen, which could lower the risk for death.¹² Although a 3-mm cannula of 15 cm with good view for controlling the tip (we never grafted intramuscularly or submuscularly) was used, a 4-mm or larger grafting cannula is recommended and now used at the Oslo Plastic Surgery Clinic. Other precautions are careful patient selection, excluding patients at high risk for complications and those with high/unrealistic expectations. Rapid mobilization postoperatively is crucial to avoid thrombosis. In addition, the volume grafted during surgery is correlated with complications, and lesser volumes can reduce complications such as compartment syndrome and skin necrosis.

These reports bring up important points regarding gluteal fat augmentation, such as where fat is grafted subcutaneously, the location of the greater sciatic foramen and surrounding vascular structure, the size of the grafting cannula 4 mm or larger, safety factors during the procedure (including constant motion of the cannula, large size of cannula, and staying above the muscle), the grafted volume when achieving the desired shape and when achieving the desired volume, and stopping when fat is overrunning the injection sites. With all precautions in mind, it is possible to lower the mortality rate (Figures 4-6).

Patients should be aware of the danger related to this operation and should be encouraged to choose surgeons

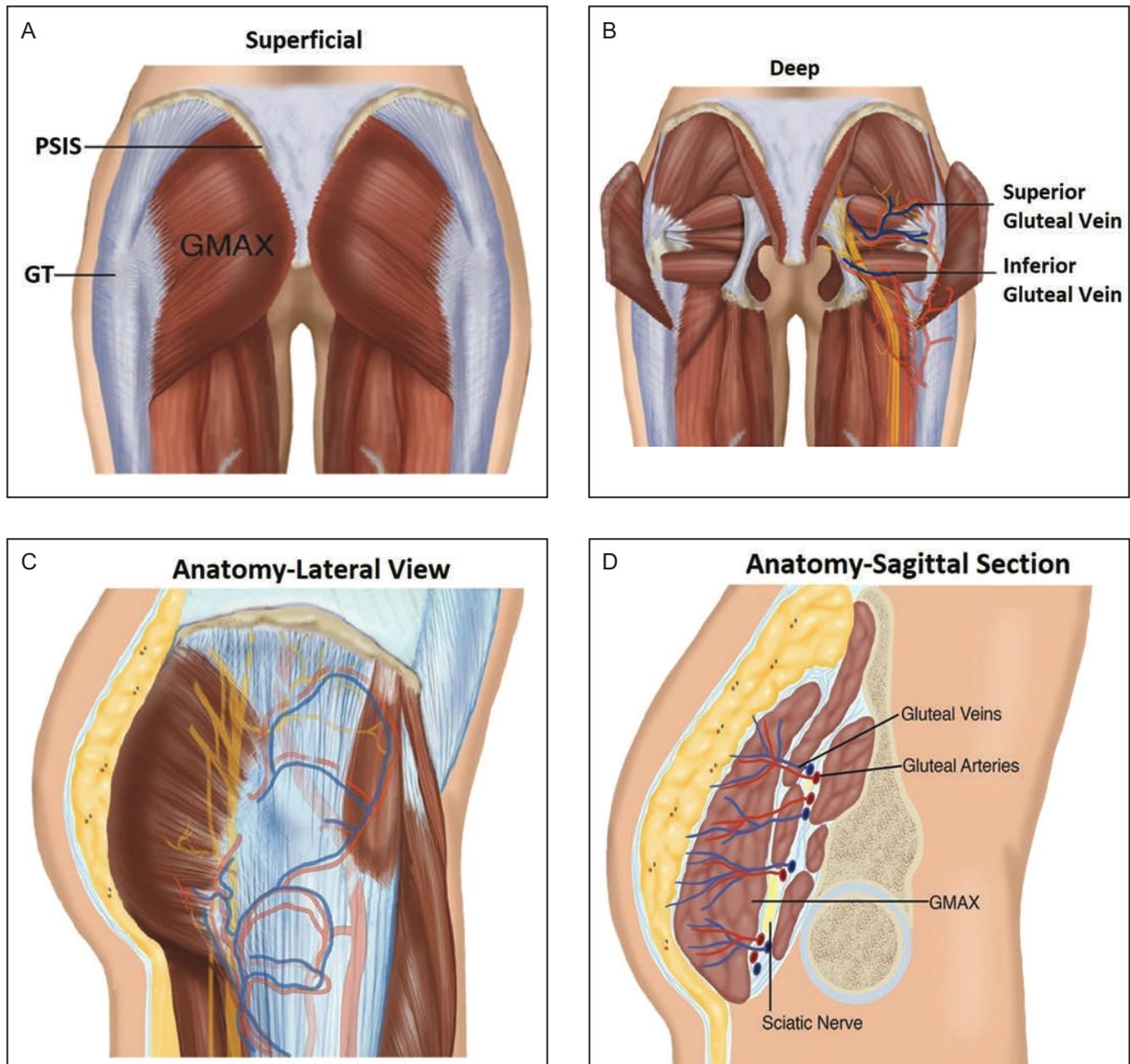


Figure 3. Posterior view of the gluteal area. (A) Superficial anatomic structures of the gluteal area. (B) Deep anatomic structures of the gluteal area with muscles elevated. (C) Lateral view of the gluteal area. (D) Sagittal view of the gluteal area showing subcutaneous fat, muscle, and blood vessels.

who are board certified in plastic surgery. The most important priority must be patient safety. One focus of our study was how to reduce mortality and morbidity rates in gluteal augmentation with fat.

Expectations and Risks

To promote realistic expectations, good patient selection should be made and information should be given. The higher the unrealistic expectations regarding volume, the higher the risk in performing the procedure. The way the media report on patients creates unrealistic

expectation for patients, which should be addressed from the first consultation.

Certainly, important points of previous studies were cited herein, including the most recent from January 2018 in our literature review. The technique described herein is the authors' own experience, and useful points are illustrated that make patient safety a priority. One main advantage offered by fat grafting gluteal augmentation is the possibility of reshaping the region to obtain universal and ethnic-specific ideals regarding beautiful buttocks. This can be achieved by combining liposuction of

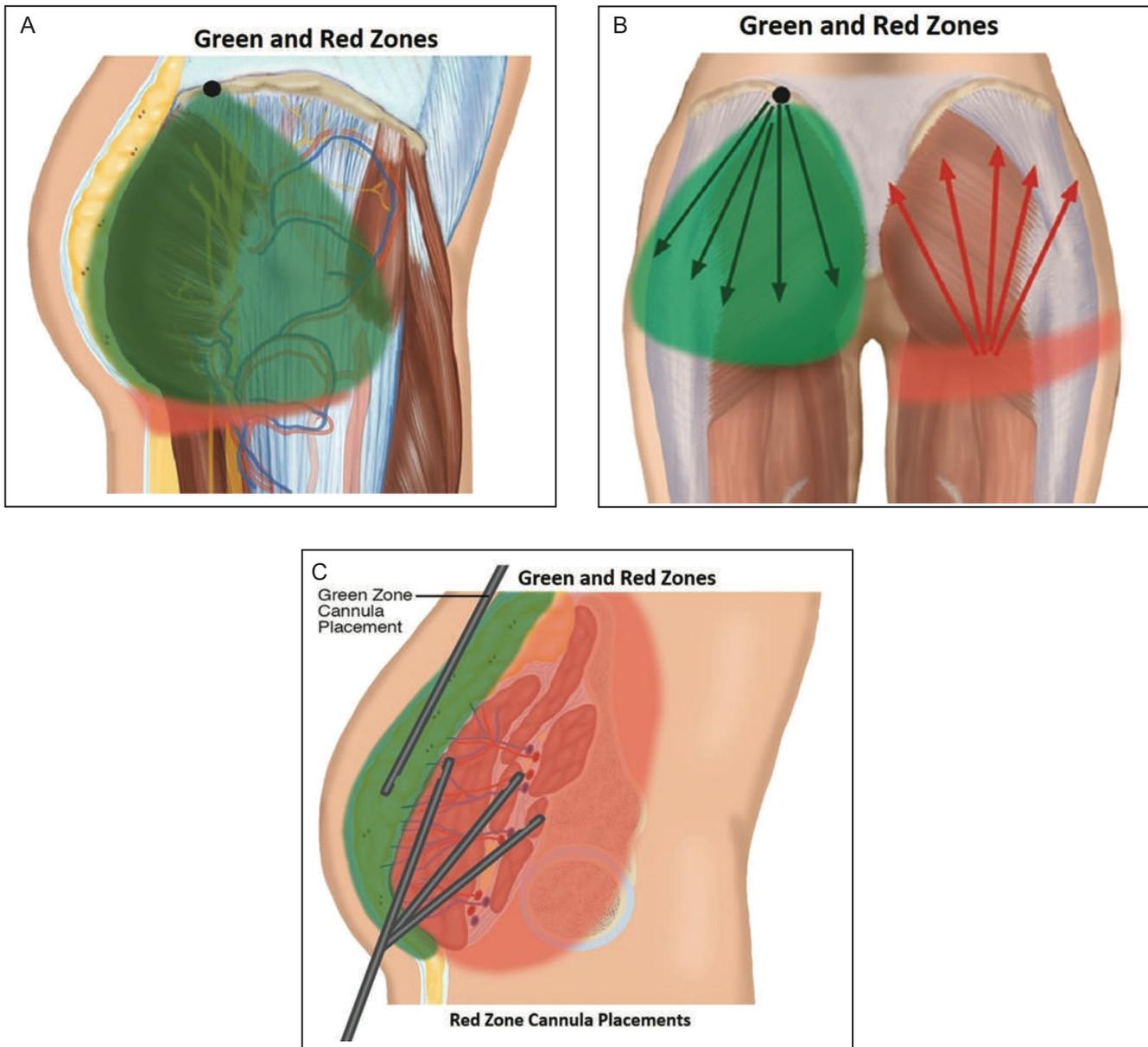


Figure 4. Zones during gluteal augmentation. (A) Green demonstrates safe zones for grafting during gluteal augmentation. (B) Green demonstrates recommended grafting incisions sites for gluteal augmentation. Red demonstrates grafting sites that should be avoided for the safety of the patient. (C) Sagittal view of the gluteal area. Green demonstrates safe zones for cannula placement during gluteal augmentation. The red zone should be avoided for the safety of the patient.

the upper and lower back and augmentation of the lateral two-thirds of the buttocks.^{17,27,28} The procedure of gluteal augmentation has the advantage of combining liposuction and enlargement, refiguring the buttocks/back and front of the patients at the same time as the upper and lower back, abdomen, and the sides, in addition to gluteal augmentation, which is a win-win situation. This should be discussed with the patient because it is not about “fat hunting” as much as correction and reshaping the back and front.

Strengths of the Study

This is a retrospective consecutive study in which the procedures are performed by a single surgeon. To our knowledge, this is the first study from Scandinavia, and probably Europe, that focuses on safety. The preoperative assessment and our criteria for performing the procedure, the moderate amount of grafted volume, the grafting level being only subcutaneous, and the discussion of safety points, such as not grafting from the infragluteal

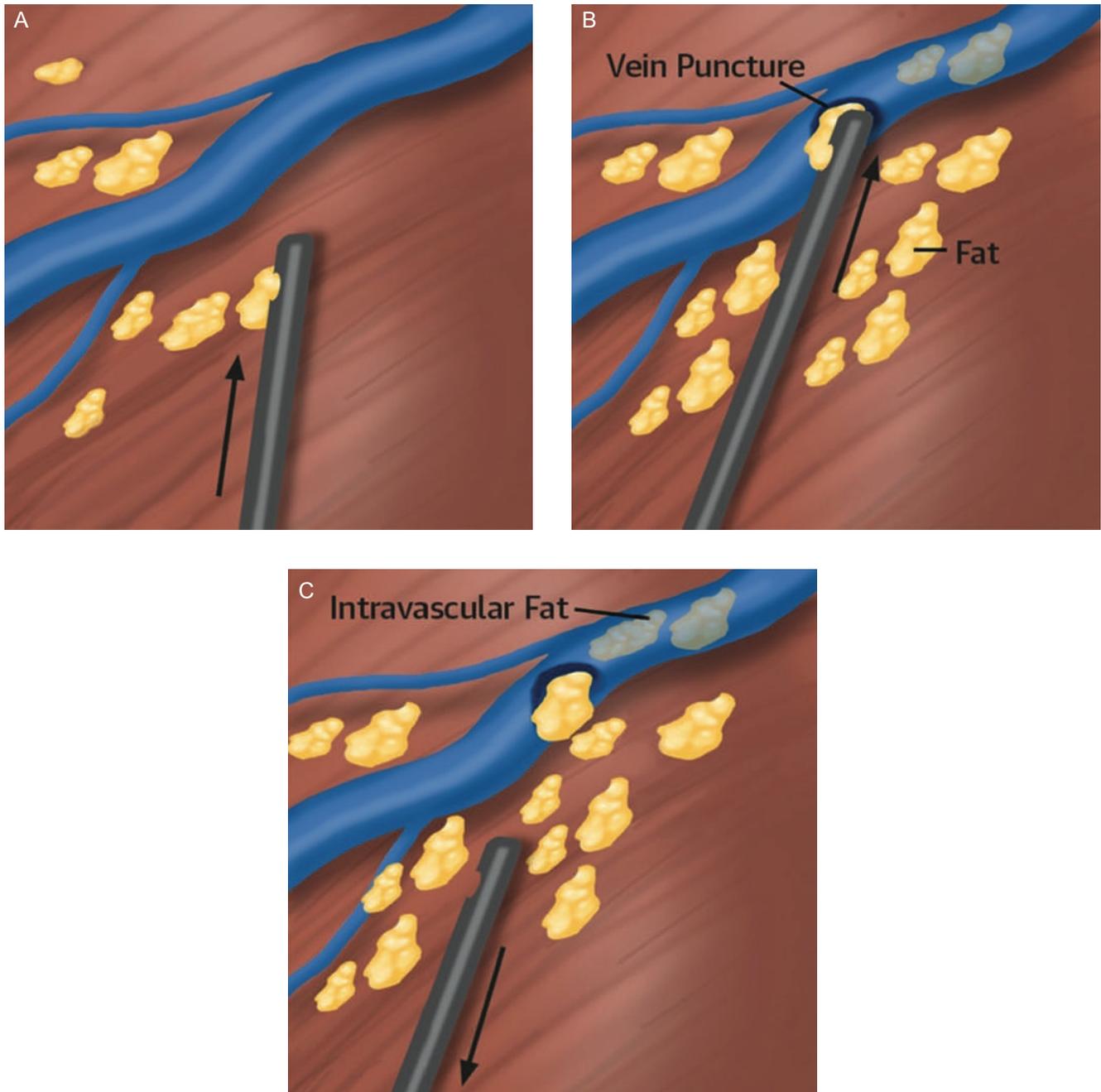


Figure 5. (A) Safe grafting does not damage the vein. (B) Demonstration of venous damage. (C) Demonstration of venous damage with intravascular fat, which results in fat emboli and should be avoided.

area and internate areas, are additional points to consider. Furthermore, the type of anesthesia used in our patients, which was only sedation and lipotumescent; the emphasis on direct mobilization of patients as they move with help from perioperative to postoperative status; the animation figures (Figures 3-6) that illustrate safety, created by the authors, are easy to understand and show how easy it is to teach the technique; and, finally, the attempt to combine a literature review of death with this procedure and a

retrospective study are all factors that enhance our consideration of patients safety.

Limitations of the Study

Although we focus on the safety issues and the technique itself, as well as an international review, longer follow-up and larger number of patients could be an advantage to the study. Furthermore, use of a quality-of-life questionnaire

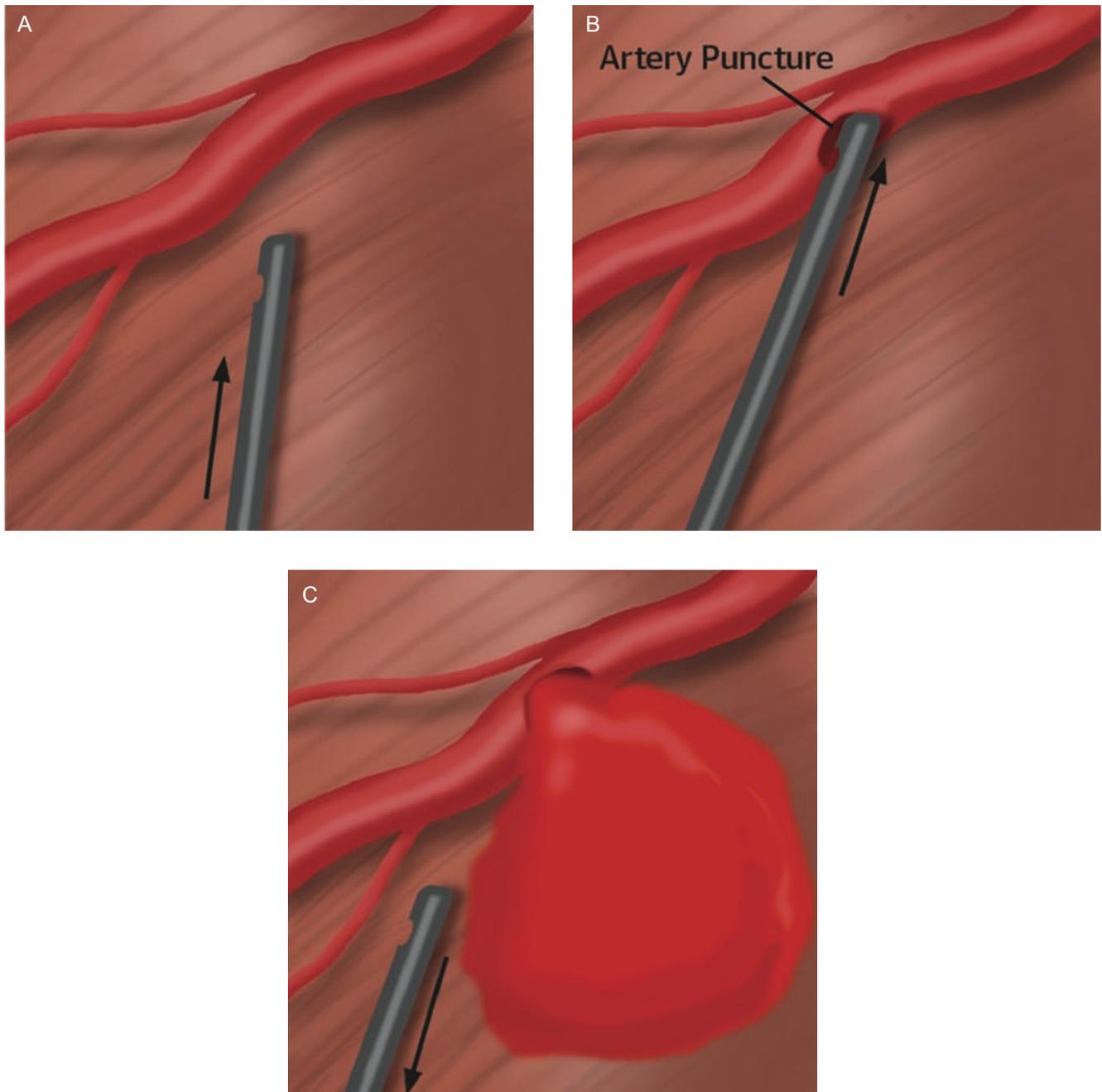


Figure 6. (A) Safe grafting does not damage the artery. (B) Demonstration of arterial damage. (C) Demonstration of bleeding after artery damage, which should be avoided.

could enhance the study. This was a retrospective study using the journal notes that the authors had for every patient. The follow-up was mainly clinical and by photographs. Patients at the Oslo Clinic are given a 1-year guarantee of a new procedure if not satisfied or if a complication occurs, which is why we believe our results are reliable. However, more accurate measurements using ultrasound and photographs could be beneficial.²⁹ Additional anonymous investigation regarding quality of

life and satisfaction could be interesting to perform later on with the same patients to see whether our assumptions correspond to the quality of life of the patients.

CONCLUSIONS

Gluteal augmentation using fat has been one of the most popular procedures in the preceding 3 years at the Oslo Clinic, and the international mortality rate is high.

Thorough selection of patients, per operative position to create a safe path for grafting in the desired planes, the use of a blunt large cannula, a superficial approach above the muscle to avoid vessel damage and avoiding grafting from an infragluteal incision are some recommendations to optimize safety. Grafting of large volumes at one time is not advised, and immediately mobilizing the patient post-operatively is essential. The results of our analysis should help increase safety in this procedure.

Disclosures

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Funding

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

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