Achieving a Predictable 24-Hour Return to Normal Activities after Breast Augmentation: Part II. Patient Preparation, Refined Surgical Techniques, and Instrumentation

John B. Tebbetts, M.D.

Dallas, Texas

The goal of this study was to develop practices that would allow patients undergoing subpectoral augmentation to predictably return to full normal activities within 24 hours after the operation, free of postoperative adjuncts. Part I of this study used motion and time study principles to reduce operative times, medication dosages, perioperative morbidity, and recovery times in augmentation mammaplasty. Part II of the study focuses on details of patient education, preoperative planning, instrumentation, and surgical technique modifications that were identified, modified, and implemented to achieve the results reported in part I.

Two groups of 16 patients each (groups 1 and 2) were studied retrospectively for comparison to a third group of 627 patients (group 3) studied prospectively. Patients in group 1 had axillary partial retropectoral breast augmentations in 1982–1983, using dissociative anesthesia, blunt instrument implant pocket dissection, and Dow Corning, double-lumen implants containing 20 mg of methylprednisolone and 20 cc of saline in the outer lumen of the implants. Patients in group 2 (1990) had inframammary, retromammary augmentations by using a combination of blunt and electrocautery dissection, Surgitek Replicon polyurethane-covered, silicone gel–filled implants, and general endotracheal anesthesia. Patients in group 3 (1998 to 2001, $n = 627$) had inframammary partial retropectoral, inframammary retromammary, and axillary partial retropectoral augmentations under general endotracheal anesthesia. Refined practices and surgical techniques from studies of groups 1 and 2 were applied in group 3.

Videotapes from operative procedures of groups 1 and 2 were analyzed with macromotion and micromotion study principles, and tables of events were formulated for each move during the operation for all personnel in the operating room. Extensive details of surgical technique were examined and reexamined in 13 different stages by using principles of motion and time studies described in part I of this study to maximize efficiency without any change in quality. Unnecessary or unproductive motions and techniques were progressively eliminated, and essential, productive techniques were streamlined to eliminate wasted time and motion. Instrumentation and surgical techniques were evaluated in detail and modified to minimize bleeding and tissue trauma.

Detailed data were presented in part I of this study that document shorter operative times, recovery times, time to discharge home, and time to return to normal activities. This part focuses on the patient education, preoperative planning, instrumentation, and surgical technique changes that were implemented on the basis of the findings in part I of the study. More extensive patient information integrated with staged informed consent resulted in a more informed and confident patient. Applying motion and time study principles to analysis and refinement of instrumentation and surgical techniques resulted in a substantial reduction in perioperative morbidity and a simpler, shorter 24-hour return to full normal activity for 96 percent of the patients undergoing breast augmentation in group 3 compared with groups 1 and 2. More than 96 percent of patients in group 3 were able to return to normal activities, lift their arms above their heads, lift normal-weight objects, and drive their car within 24 hours after their partial retropectoral breast augmentation.

Patient education, preoperative planning, instrumentation, and surgical technique modifications based on motion and time study video analyses reduced surgical trauma and bleeding, reduced perioperative morbidity, and allowed 96 percent of 627 breast augmentation patients in group 3 a predictable return to full, normal activity in 24 hours or less. Specific surgical factors that contributed to these results included (1) prospective hemostasis techniques with a zero tolerance for even the smallest amount of bleeding, (2) strict "no-touch" techniques for periosteum and perichondrium, (3) eliminating all blunt dissection, (4) performing all dissection under direct vision, (5) modified and simplified instrumentation, and (6) optimal use of muscle relaxants during subpectoral dissection. (*Plast. Reconstr. Surg.* 109: 293, 2002.)

Received for publication February 9, 2001; revised November 1, 2001.

Dr. Tebbetts is a consultant to McGhan Medical Corporation and Genzyme Snowden Pencer. He receives financial benefits from these companies. Breast implant products and surgical instruments distributed by these and other companies are mentioned in this paper.

Part I of this study[1] used motion and time study principles to reduce operative times, medication dosages, perioperative morbidity, and recovery times in patients undergoing augmentation mammaplasty. A reduction in perioperative morbidity and a 24-hour return to normal activities in 96 percent of patients resulted from increased surgical efficiency, shorter operative times, decreased numbers and dosages of drugs administered intraoperatively and postoperatively, and reduced surgical trauma. Part II addresses refinements in instrumentation and surgical techniques that are essential to reduce surgical trauma and bleeding and to improve efficiency to shorten operative and recovery times.

METHODS

Motion and Time Study Applied to Surgery

Motion and time study principles detailed in part I of this study were used to examine every detail of anesthesia, instrumentation, and surgical technique in each of the three groups of patients. Unedited videotapes of augmentation mammaplasties from each group were digitized and analyzed in minute detail on a nonlinear digital video editing system. Every move and technique was listed in tables in Microsoft Word. A total of 13 reviews and revisions of these tables requiring more than 200 hours of surgeon time were completed before implementing changes that were subsequently applied in group 3 procedures. Additional three-camera video of inframammary, partial retropectoral augmentations and axillary partial retropectoral augmentations in patients in group 3 was recorded at three intervals after implementing technique changes in stages. At each interval, the unedited videotapes were reviewed, and further changes were made to the tables of events and subroutine scripts for the surgeon and personnel to follow intraoperatively. Major instrumentation and technique modifications were completed by November 1997 before initiating data collection on patients in group 3 in January 1998.

Specific subroutines were identified and timed from representative videotapes of each group, including bilateral pocket dissection, hemostasis, implant sizer use, implant selection, implant preparation and filling, pocket tailoring, implant removal and replacement, and incision closures. These subroutines were then expressed as a percentage of total operative time, and these percentages were then applied to total average operative times for each group to derive average subroutine times for each group. Each subroutine of surgical technique and instrument use was critically examined and modified to eliminate bleeding and reduce tissue trauma.

Final scripts for each detailed step in the operation evolved from the modified tables of events. Detailed subroutines were created for each step or set of actions. Optimal instrumentation selection, positioning, and use were integrated into the scripts for surgeon review, training, and reference on a computer screen in the operating room. In addition to preoperative study of the scripts and subroutines, scripts were read aloud in stages during the operation, in advance of the surgeon performing each subroutine in technique. Postoperatively, scripts were immediately updated to reflect improvements noted intraoperatively. Part I of this study details operative and postoperative events recorded by using the events bar-coding data entry system and database and methodologies for collection and analysis of perioperative and postoperative data.

Patient Education and Preoperative Planning

Patients in group 1 received a patient information sheet of approximately eight typed pages that presented concepts and information essential to adequate informed consent according to state recommendations in the early 1980s. This information sheet contained postoperative instructions, and the patients signed a single-page operative consent form. Questions were answered in one or two preoperative office visits, and operative consent forms were signed. Preoperative planning in patients in group 1 consisted of asking the patient what bra cup size she would like to be, allowing her to place sizer implants in a bra, and selecting the final volume implant at the time of surgery, with or without the use of reusable silicone gel sizer implants intraoperatively.

Patients in group 2 in 1990 received a similar, but more extensive patient information sheet of approximately 15 typed pages, expanded from the previous version on the basis of the additional experience and perceived patient needs. The patients also received information materials available from professional societies and signed a single-page operative consent form. Preoperative planning for patients in group 2 was similar to group 1, except

that measurements of the base width of the patient's existing parenchyma and intermammary distance were considered, mainly with respect to choosing implants at least as wide or wider than the patient's existing parenchyma to predictably and maximally narrow the intermammary distance or cleavage to meet the patient's requests.

All patients in group 3 received a copy of a book on breast surgery after an initial telephone call to our office.[2] After documenting required reading of the book, each patient had a consultation of at least 45 minutes with a specially trained patient educator who followed a detailed checklist to assure the patient's understanding of the information presented in the book and in informed consent documents. During the patient educator consultation, the patient documented preliminary preferences for incision location, pocket location, and implant type and size, or assigned those choices to the surgeon.

At a separate surgeon consultation, the surgeon reconciled the patients expressed preferences with her tissue characteristics to derive a mutually acceptable set of final choices documented during the consultation. Tissue measurements of multiple breast parameters were integrated into a simplified and refined operative planning and implant selection system, modified to include stretch characteristics of the patient's envelope.[3] This system of selecting an appropriate implant on the basis of patient tissue characteristics is applicable to all types of implants and is designed to minimize the necessity of ordering multiple implant sizes, eliminate use of sizers in the operating room, implant changes, and unnecessary intraoperative decisions. An extensive set of informed consent documents was presented in stages to the patient as part of her consultations with the patient educator and surgeon. This sequential, detailed informed consent process is detailed in another publication.[4] All patients in group 3 were offered a choice of every type of saline-filled implant available at the time of the study (textured, smooth, round, and anatomic from three manufacturers) and asked to express their preference before their surgeon consultation. Preoperatively, all patients in group 3 received detailed information about what to expect postoperatively, postoperative instructions, and demonstrations of arm raising exercises to perform immediately postoperatively.

Instrumentation and Techniques

To evaluate surgical techniques and instrumentation, a meticulous, detailed approach addressed the necessity and function of every instrument and every technique. No technique or instrument was excluded from scrutiny because it was considered essential. The following questions, derived from motion and time study principles, were asked about each instrument and subroutine in surgical technique: (1) Can I eliminate this step or instrument? (2) Can I combine this step with another step or steps? (3) Can I rearrange the steps to make the flow shorter or smoother or both? (4) Can I simplify the step? (5) Does this step and setup minimize the number of instruments required and the number of instrument motions? (6) How can this step be performed or instrument used to reduce tissue trauma? (7) Can the changes be made without any sacrifice of quality? and (8) Does this technique or instrument optimally eliminate bleeding and reduce tissue trauma?

On the basis of evaluations of videotapes of groups 1 and 2 by using motion and time study principles, instrumentation was optimized for efficacy and efficiency, and lists of optimal instrumentation were derived for use in group 3. Five different brands of operating tables were compared for optimal side-to-side patient positioning to allow the surgeon to dissect both pockets from one side of the table.

Dissection Sequence

Motion and time study evaluations produced specific sequences of pocket dissection for each incision approach that (1) identified the easiest and most predictable area for entry into the subpectoral pocket from the incision traversing minimal normal tissue to gain access and (2) established progressively increasing exposure in noncritical areas (fewest neurovascular structures or difficult anatomy) before proceeding to (3) areas with less predictable anatomy with more neurovascular structures to (4) provide optimal prospective exposure for control should any vascular structure be interrupted without prior control. In groups 1 and 2, the surgeon moved from one side of the operating table to the other to dissect the respective pockets. In patients in group 3, the surgeon dissected both pockets from the same side of the table.

Surgical Techniques

In all patients in group 1 (axillary, partial retropectoral approach), pocket dissection was performed by using a urethral dilator or blunt metal dissector. Dissection in patients in group 2 (inframammary, partial retropectoral) was performed by using pencil needle-point electrocautery in the lower pocket and blunt finger dissection in the upper pocket. No blunt dissection of any type was used in any area of the pocket in patients in group 3, completing all pocket dissection by using hand-switching, monopolar, needle-point electrocautery forceps.

All group 3 procedures were carried out by using strict sequences and techniques defined in surgeon and personnel scripts derived from motion and time study analyses of group 1 and 2 cases.

Details of surgical technique are presented in the surgical subroutine steps in the surgeon scripts (Table I). In the inframammary, partial retropectoral augmentations in group 3, the approach to the subpectoral plane was individualized according to the principles described in my article on dual plane augmentation.[5]

Hemostasis

In patients in group 1, hemostasis in the dissected pocket was achieved by holding pressure over the entire pocket for at least 5 to 10 minutes then irrigating the pocket with sterile saline and repeating the application of pressure until the irrigant cleared to a pink color. In patients in group 2, hemostasis was established by using a combination of pressure and direct electrocoagulation of bleeders after dissection. In patients in group 3, principles of prospective hemostasis that are defined and discussed later in this paper were applied in every case, attempting to prevent even the most minor bleeding before it occurred. Times required specifically for hemostasis were recorded from a live, unedited videotape of an axillary augmentation in group 1, an inframammary augmentation in group 2, and for both an axillary and an inframammary augmentation in group 3.

Pocket Irrigation

After achieving hemostasis, the dissected pockets of all patients in groups 1, 2, and 3 were irrigated with sterile saline followed by irrigation with Betadine diluted 50 percent with sterile saline (until the FDA ban on the use of Betadine), removing all excess solution by suction.

TABLE I

Surgeon Script* (Excerpt) for Group 3 Inframammary, Partial Retropectoral Augmentations

Tasks	Anesthesia	Surgeon	Assistant	Scrub	Circulator
Inferomedial pocket development					
Enlarge lower medial pocket inferiorly, aim toward sternum 4 cm superior to junction with IMF, think about location of second inferomedial perforator, advance retractor cautiously.		X			
Begin division pec origins along IMF 1 cm above proposed new fold from undersurface, divide in small increments		X			
Expose lower muscle incision line 1 cm above proposed new IMF		X			
Look medially for second large perforator before advancing retractor, pinch coagulate proximal and distal, divide		X			
Incrementally incise/divide pec across IMF		X			
Check skin markings and topography during muscle division					
When muscle division is complete inferiorly and medially to junction of IMF with sternum, look for vessels in muscle stumps and subQ tissue along muscle division line as retractor is withdrawn		X			
With index finger, palpate line of muscle division along IMF from medial to lateral to ensure complete release		X			

IMF, inframammary fold; pec, pectoralis; subQ, subcutaneous.

* Table I is an excerpt from complete surgeon scripts for inframammary and axillary augmentation that are available for download from the Journal's Web site at *http://www.plasreconsurg.org*.

Implant Preparation, Filling, and Insertion

All implants in all groups were prepared according to manufacturers' recommendations in literature accompanying the implants. Details of the changes in implant preparation and filling techniques are omitted at the request of reviewers to shorten the paper.

Implant Sizers

Reusable silicone gel–filled implant sizers were used in 11 of 16 cases in group 1 and in 7 of 16 cases in group 2. No implant sizers were used in any patient in group 3.

Timed Events Recorded

Representative unedited videotapes from each group were reviewed and times required were recorded for each of the following: pocket dissection, hemostasis, implant sizer use, implant selection, implant filling adjustments, pocket tailoring adjustments, and intraoperative implant removal and replacement for any reason.

Clinical Experience and Results

Procedures for patients in group 3 ($n = 627$) were performed during a 3-year period from January 1998 to January 2001; 533 patients had an inframammary, partial retropectoral approach, 35 patients had an inframammary, retromammary approach, and 59 patients had an axillary, partial retropectoral approach.

Surgeon Scripts

Table I is an excerpt from the surgeon script used for patients in group 3 undergoing inframammary, partial retropectoral augmentation. The entire 18-page script is available for download from the Journal's Web site at *http://www.plasreconsurg.org*. A similar script for axillary partial retropectoral procedures is also available for download.

Timed Events

Intraoperative subroutines that directly relate to preoperative planning include pocket dissection time, hemostasis, implant sizer use, implant selection, implant filling adjustments, pocket tailoring adjustments, intraoperative implant removal and replacement for any reason, and total operative times. Table II lists average time intervals required for each of these subroutines from representative videotapes for groups 1, 2, and 3.

Instrumentation

During the motion and time study evaluations, to increase efficiency and efficacy, the number of instruments was progressively reduced to those that were essential and optimally functional, and retractor designs were altered to optimize efficiency and minimize trauma.

Dissection Sequence and Techniques

Figure 1 (*left*) illustrates the basic dissection sequence applied in patients in group 3 undergoing inframammary approach augmentation, and Figure 1 (*right*) illustrates the sequence applied in patients in group 3 undergoing axillary augmentation. Regardless of the incision approach, absolutely all dissection in patients in group 3 was completed under direct vision by using monopolar electrocautery instruments. No blunt, blind, or sharp dissection was used in any area except skin incision, and strict prospective hemostasis and "no-touch" techniques for periosteum and perichondrium were used in all patients. Using these techniques, there was no difference in time to return to normal activities or other complica-

TABLE II

Average Times Required for Specific Intraoperative Subroutines (Rounded to Nearest Minute)

Subroutine	Group 1 Axillary	Group 2 Inframammary	Group 3 Inframammary	Group 3 Axillary
Pocket dissection (bilateral)	25	35	12	26
Hemostasis	10	10	2	2
Implant sizer use	7	10	0	0
Implant selection	3	5	0	0
Implant preparation and filling	10	10	5	5
Pocket tailoring	8	5	1	1
Implant removal and replacement introperatively	5	4	0	1
Incision closures	10	10	6	10
Total operative times	78	89	26	45

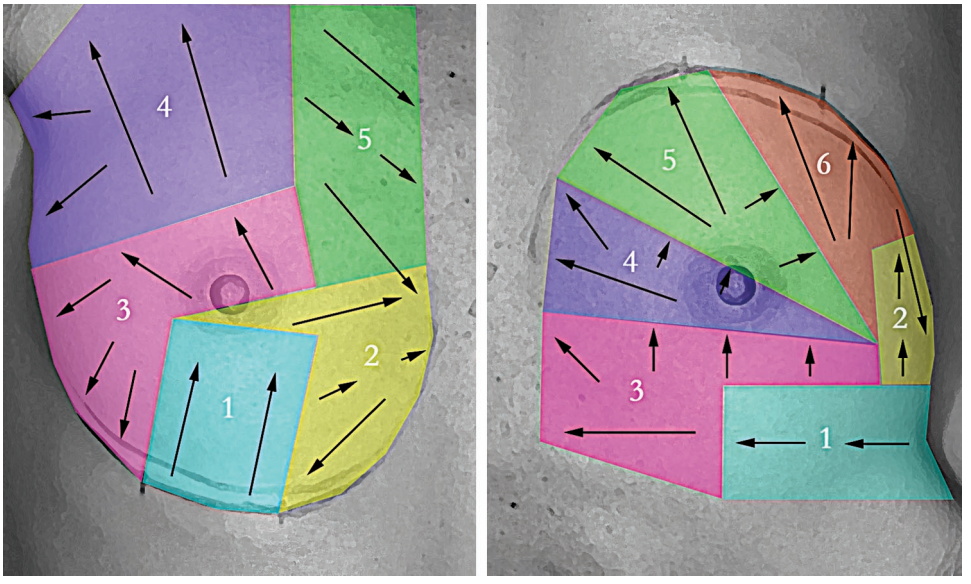

FIG. 1. (*Left*) Sequence of pocket dissection for inframammary, partial retropectoral augmentation. (*Right*) Sequence of pocket dissection for axillary, partial retropectoral augmentation.

tions in the patients with partial retropectoral augmentation compared with the patients with retromammary augmentation.

Surgical Techniques—Axillary and Inframammary

The initial table of events for inframammary partial retropectoral augmentation before modification contained 310 events, and the final surgeon script contains 116 events, a 63 percent reduction in total events. Table I is an excerpt from the surgeon script for patients with group 3 axillary, partial retropectoral augmentation. The initial table of events for axillary partial retropectoral augmentation before modification contained 263 events, and the final surgeon script contains 112 events, a 57 percent reduction in total events. All patients in group 3 (n = 627) had all aspects of the operation performed under direct vision or with endoscopic assistance, with no blind, blunt, or sharp dissection in any area, minimizing bleeding and tissue trauma while simultaneously reducing the total number of surgical events.

Hemostasis

Times required for hemostasis related activities and events are listed in Table II. No drains were placed in any patient in group 3. Patients in groups 1 and 2 were not specifically questioned and data were not recorded for the occurrence of ecchymosis following their procedures, but ecchymosis in the inframammary fold region and lateral thoracic areas was common in patients in group 1 and 2 postoperatively. Patients in group 3 were specifically questioned, and data was recorded for the occurrence of ecchymosis. Of 627 patients in group 3, including those with axillary and inframammary approaches, only 26 patients (4.1 percent) developed any ecchymosis postoperatively. Two hematomas (0.3 percent of patients, 0.2 percent of breasts) occurred in patients in group 3. No drains were placed in any patient in any of the three groups, and no bras or compression devices were placed on any patient in group 3. All patients in group 3 were encouraged to return to full normal activity immediately, and all received 800 mg of ibuprofen for discomfort postoperatively.

Implant Preparation and Filling

Times required for implant preparation and filling are listed in Table II. A substantial reduction in average time required for irrigation was accomplished in patients in group 3 (5 minutes, a 50 percent reduction compared with group 1 and a 50 percent reduction compared with group 2). On the basis of evaluations of group 1 and 2 procedures, implant submersion leak testing was completed by the assistant before beginning the operation. The implants, with fill tube and stopcock inserted, were placed on the patient's abdomen by the scrub nurse, and the surgeon lifted the implant out of its thermoform packaging and placed

the implant on the inverted thermoform packaging for air evacuation and preparation to avoid contacting anything on the operative field. Air evacuation was rapidly accomplished in group 3 by using a closed suction system attached to the implant fill tube and a stopcock with the implant resting on the inverted thermoform packaging. Implant air evacuation, rolling, fill tube orientation, and insertion in group 3 were all completed in a series of three motion subroutines carried out in a linear pattern from instrument tray to incision to minimize surgeon movements and implant contact with objects or persons in the operative field.

Implant Sizers

Reusable silicone gel–filled implant sizers were used in 11 of 20 cases in group 1, 7 of 16 cases in group 2, and no implant sizers were used in any patient in group 3. Comparisons of times for sizer use related activities and motions are listed in Table II.

DISCUSSION

Although increased efficiency in the operating room substantially reduces anesthesia times and drug doses that impact patient recovery, the most important factors that affect recovery are the amount of bleeding and tissue trauma that occur intraoperatively. Surgical techniques and instrumentation are available that can reduce bleeding to less than 1cc in virtually every augmentation, regardless of incision approach or pocket location. Precise control of dissection under direct visualization by using monopolar electrosurgical instruments, totally eliminating any blunt dissection, dramatically reduces tissue trauma. Application of these techniques and instrumentation is straightforward and within the capabilities of any surgeon.

Motion and Time Studies

An objective, isolated critique of subroutines in surgical technique provided a perspective that was totally different from any surgical evaluation or education techniques the author has experienced in 7 years of surgical residency and 21 years of clinical practice and produced improvements that far exceeded expectations. As routine techniques were subdivided into individual motions and subjected to increasing levels of detailed critique, three distinct areas that affect outcome were apparent: (1) a massive number of motions and events that were considered sacred and inviolate in the author's surgical education and evolution were totally ineffective and time wasting, (2) many details of routine surgical techniques were inadvertently producing unnecessary tissue trauma and bleeding that subsequently affected inflammation and wound healing processes, and (3) large numbers of totally unproductive and time-wasting events were present in procedures that were supposedly efficient by current standards.

During the 3-year period of this study, a total of 577 surgeon hours were saved in the operating room alone, a net savings of 377 hours (47 eight-hour days) after subtracting the 200 hours required to perform the video analyses. This figure is derived by multiplying the average time savings per operation in patients in group 3 compared with patients in group 2 by the number of operations performed on patients in group 3. Further savings are reflected in the recovery times, medication costs, and patient morbidity decreases reported in part I of this study.

Patient Preparation and Operative Planning

Using the preoperative planning methods detailed in other publications[3,6] focusing on quantifiable breast dimensions and tissue characteristics, intraoperative decision-making times were dramatically reduced in group 3 compared with groups 1 and 2. Implant selection for primary breast augmentation is a very straightforward process that can always be performed preoperatively, provided the surgeon is willing to learn or develop the methodology. Preoperative implant selection has the following direct and potential benefits: (1) It reduces time waste and delivery costs by eliminating the necessity of ordering multiple implant sizes available for each case, and 2) it eliminates use of implant sizers or multiple implant insertions that waste time, increase tissue trauma, and increase risks of pocket contamination.

Instrumentation

Optimal instrumentation is absolutely essential to successfully execute the details of the techniques in this study and cannot be over emphasized.

Dissection Sequence

A predefined, detailed dissection sequence tailored to the incision approach and pocket anatomy is invaluable to surgical efficiency, re-

duction of tissue trauma, and potential morbidity in breast augmentation. Depending on pocket location (retromammary, partial retropectoral, or dual plane[5]) from each incision approach, an optimal route and dissection sequence minimizes trauma to adjacent tissues.

Surgical Techniques—Axillary and Inframammary

Bleeding and tissue trauma caused by the surgeon are the major causes of perioperative morbidity and prolonged recovery in breast augmentation. Many established, effective surgical techniques used during the past four decades are responsible for the lack of progress in shortening patient recovery times in breast augmentation. Traditional surgical techniques use sharp or blunt dissection techniques to develop the implant pocket, inherently producing bleeding that requires subsequent hemostasis by pressure or electrocautery or both. Although these techniques are effective at achieving hemostasis, a substantial amount of blood remains in the tissues in and around the implant, producing substantial inflammatory response postoperatively and contributing to patient pain and prolonged recovery.

In patients in group 3, regardless of incision, pocket location, or implant type, surgical techniques focused on the following principles:

1. All dissection is completed under direct vision or endoscopic vision for optimal control and prospective hemostasis, with no blind dissection in any area of the pocket.
2. All pocket dissection is completed with monopolar, hand-switching electrocautery forceps or, in endoscopic cases, with an Ethicon Probe Plus II electrocautery dissection instrument (Ethicon Endosurgery, Inc., Cincinnati, Ohio). Blunt dissection is never used in any area for any reason.
3. Strict no-touch techniques for periosteum and perichondrium are used in subpectoral pocket dissections to eliminate any contact with or bleeding from small surface vessels on rib periosteum or costal cartilage perichondrium.
4. All retraction instrumentation and techniques are designed to minimize retraction forces, bleeding, and trauma to tissues caused by the retractors. Whenever a retractor is moved, replaced, or removed, another instrument keeps overlying soft tissues elevated to avoid retractor contact with periosteum or perichondrium.

Prospective Hemostasis

One of the most important processes in the refined surgical techniques is prospective hemostasis, a term that describes a process of avoiding bleeding by controlling vessels before bleeding occurs and manipulating instrumentation to prevent inadvertent disruption of small vessels. This simple concept is challenging to even the most experienced surgeon because it requires developing a different mindset for the operation that follows rigid guidelines. Requirements for prospective hemostasis are as follows:

1. Zero tolerance for even the most minor bleeding, developing the entire implant pocket with less than 1 cc total bleeding.
2. Detailed knowledge of vascular anatomy and variations and a commitment to see every blood vessel of 0.5 mm and larger before dividing it. The surgeon must be totally knowledgeable of the exact anatomic locations of blood vessels, including the smallest vessels, and develop a mindset that absolutely no bleeding should occur during the operation. Although zero bleeding is technically impossible with current techniques, the mindset and execution of techniques to approach total, prospective hemostasis predictably reduces bleeding in the operation to less

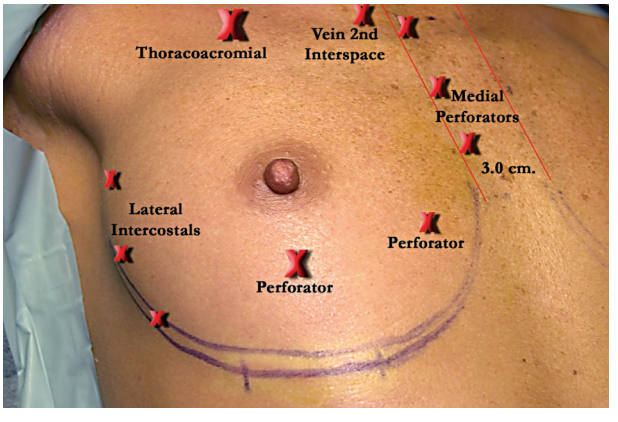

FIG. 2. Location of the most significant blood vessels encountered when dissecting a subpectoral pocket. Medially, the large medial perforators are usually located approximately 1 cm lateral to the midline. Stopping medial dissection at least 1.5 cm lateral to the midline usually avoids these vessels. The large vein at the second interspace is located slightly more laterally and should be avoided during upper medial pocket dissection.

than 1 cc, regardless of the approach. Locations for the most common vessels encountered in the inframammary subpectoral pocket dissection are shown in Figure 2.

3. Optimal, accurate retractor placement. The surgeon must consciously visualize the location of vessels ahead of the location of dissection, placing retractor instrumentation at each step only to the previous extent of pocket dissection to optimize visualization of subsequent vessels before advancing the retractor for the next step. Avulsing small or larger vessels with routine retractor placement is a common technical error that allows small or large amounts of blood to enter adjacent tissue, requiring a greater and more prolonged inflammatory response for postoperative resolution.
4. A single instrument for dissection and hemostasis. For optimal prospective hemostasis, the same instrument should be used for dissection and definitive hemostasis, performing both functions optimally and simultaneously. A single instrument should be capable of dissecting accurately and controlling even the largest blood vessel. Any type of blunt or sharp dissection, regardless of the instrument used, is incapable of prospective hemostasis because each causes bleeding that must be stopped. Once bleeding occurs, time and additional techniques (e.g., pressure or electrocoagulation) are required to establish hemostasis. Regardless of how rapidly these techniques can be applied, more blood enters adjacent tissues compared with techniques in which no bleeding occurs. If a needle-point or blade electrocautery is used for dissection, interruption of larger perforating vessels requires the surgeon to perform at least two unnecessary moves, exchanging the needle-point or blade pencil instrument for a grasping or electrocautery forceps instrument to control the vessel. Additional assistant motions are required to clear blood from the field. The bleeding that has occurred obscures anatomic detail, wastes time, and allows blood to soak into adjacent tissues. A single instrument for dissection and hemostasis drastically reduces or eliminates multiple time-wasting motions, irreversible increased tissue trauma, blood in tissues, and obscured anatomic detail.
5. Optimal electrocautery instrumentation and settings. The most effective instruments identified in this study for simultaneous dissection and hemostasis are a hand-switching, monopolar, needle-tip electrocautery forceps (9.5 inch with a C needle-point tip; Genzyme Snowden Pencer, Tucker, Ga.) (Fig. 3) for inframammary and initial, upper axillary pocket dissections. This needle-tip, monopolar hand-switching electrocautery forceps focuses blended cut and coagulation current for optimal dissection, efficiently cutting with simultaneous hemostasis while avoiding excessive current spread and tissue charring. When any vessel is visualized or inadvertently cut, the instrument is already in the surgeon's hand at the exact site of the bleeding, allowing rapid control of the vessel in most instances without sponging or suctioning to clear the field. This instrument should always be washed, wrapped, and sterilized in a separate container from other instruments to reduce risks of current leaks that can occur from minor, almost invisible punctures to the insulation. The electrocautery generator used in this study, a Valleylab Force 2 (Valleylab, Boulder, Colo.), was selected for its combined efficacy and cost effectiveness. Generator settings of 50 cutting, 50 coagulation, with

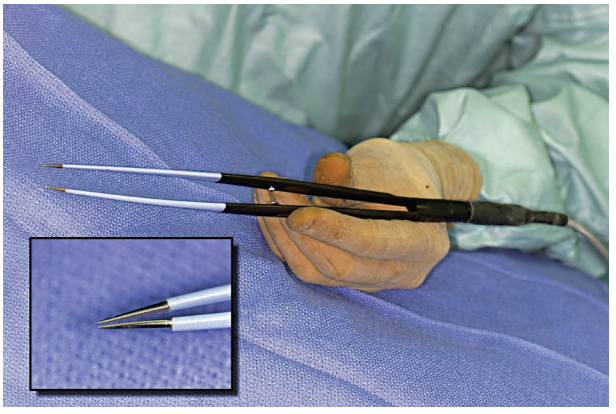

FIG. 3. Long, monopolar, hand-switching electrocautery forceps with an extremely pointed tip (inset) are used for the entire pocket dissection. The pointed tip focuses current for optimal dissection functions. Using this single instrument for dissection and hemostasis obviates the necessity of changing instruments when a larger blood vessel is encountered, reduces bleeding and tissue staining, and optimizes efficiency.

Blend 3 setting to blend cutting and coagulation currents, produced predictable, effective cutting and coagulation functions in all group 3 cases. Other electrocautery generators may also be effective, but the surgeon should critically and methodically optimize the settings to achieve optimal cutting and coagulation with minimal current spread and tissue charring. Initial dermal and subcutaneous dissection and hemostasis were most effective using a hand-switching needle-point electrocautery pencil through the fascia overlying the pectoralis, then switching to the unipolar forceps. An additional instrument, an Ethicon Probe Plus II pistol grip electrocautery dissection instrument with suction and irrigation capabilities, optimizes control for endoscopic dissection of pockets through the axillary approach.

6. A constant, focused, prospective mindset. The surgeon must constantly think ahead of the specific technique subroutine that is occurring and focus on the probable location of the next vessels encountered in the dissection sequence. This focus optimizes the likelihood of identifying vessels before cutting them and before inadvertently avulsing them or bluntly disrupting them with a retractor. Constant vigilance to prevent even the most minor bleeding and to avoid touching any rib periosteum or perichondrium dramatically reduces postoperative inflammation and patient discomfort.

Implant Preparation and Filling

Implant preparation and filling routines were major areas of improvement in time savings and potential morbidity after motion and time study analysis. Times for these maneuvers in groups 1 and 2 were 10 minutes for each group. The time of 5 minutes in group 3 represents a 50 percent reduction in time required to perform these functions. Efficiency is improved, and potential implant damage and contamination are reduced by optimizing these subroutines.

Implant Sizers

Implant sizer devices are unnecessary in almost all primary breast augmentations, provided a surgeon is willing to learn well-described methods for preoperative evaluation and implant selection based on patient tissue dimensions and characteristics.[3,6,7] Reusable implant sizer devices are common, and many have been resterilized and reused in dozens, if not hundreds of cases, increasing risks of potential bacterial or fungal contamination. Disposable sizers increase costs, waste time, and increase tissue trauma and risks of pocket contamination. On the basis of the data in Table II, use of implant sizers wastes time intraoperatively. Insertion of additional devices into the periprosthetic pocket increases contamination risks. Improving preoperative planning and selecting the implant preoperatively avoids all of the inherent time waste, tissue trauma, and contamination risks when using implant sizers.

Periostreum-Perichondrium Trauma

Although I performed axillary augmentations by using blunt dissection in patients in group 1 for almost 10 years, I never considered the potential morbidity from trauma to periosteum and perichondrium until I sustained rib fractures. This experience prompted a new focus on details of a subpectoral augmentation technique that traumatize periosteum and

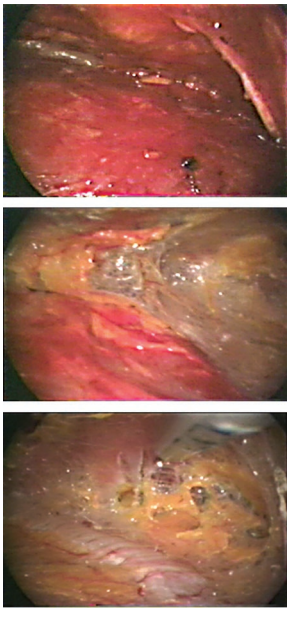

FIG. 4. Differences in bleeding and tissue staining in a bluntly dissected area compared with an area dissected using electrocautery with prospective hemostasis techniques. (*Above*) Endoscopic view of upper subpectoral pocket dissected by using finger dissection to easily separate the pectoralis major from the underlying pectoralis minor. (*Center*) Transition area showing bluntly dissected area at left and electrocautery-dissected area at right. (*Below*) Pocket dissection with electrocautery demonstrates absence of bleeding and tissue staining with intact vessels on the surface of rib perichondrium.

perichondrium tissues, which are major sources of painful sensory stimuli. All blunt dissection techniques with any metal instrument cause significant trauma to periosteum and perichondrium, with bleeding from surface vessels and resultant subperichondrial hematomas that can be easily visualized by inserting an endoscope and closely examining the periosteum and perichondrium after an axillary, blunt dissection augmentation. Blunt finger dissection, though less traumatic than metal dissectors, avulses small vessels that retract and bleed beneath periosteum and perichondrium, verifiable by endoscopic examination of a finger-dissected pocket (Fig. 4, *above*). This unnecessary trauma to sensitive tissues can be eliminated or dramatically reduced by eliminating all blunt dissection and substituting precise electrocautery dissection (Fig. 4, *below*). No technique of blunt dissection can approach the level of prospective hemostasis, minimal tissue trauma, amount of blood remaining in the tissues, and subsequent inflammation compared with the electrocautery dissection techniques used in group 3, evidenced by the 96 percent of patients reported in part I of this study that returned to full normal activity in 24 hours.

Other technical details are important to minimizing trauma to periosteum and perichondrium. During insertion of any fiberoptic retractor, the fiberoptic bundle or smoke evacuation tube can inadvertently contact periosteum or perichondrium, causing bleeding from periosteal or perichondrial surface vessels (Fig. 5). A strict, no-touch approach to periosteum and perichondrium requires that the dissecting forceps or a previously placed retractor maintain elevation of the soft tissues when inserting a retractor or exchanging it for another retractor. When advancing a retractor, maintaining elevation of the soft tissues with the dissecting forceps is helpful to avoid retractor contact with periosteum. These seemingly insignificant maneuvers to reduce trauma to periosteum and perichondrium are important to achieving the results demonstrated by patients in group 3.

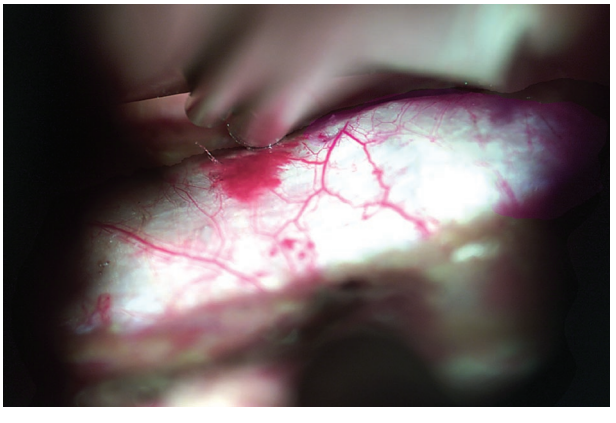

FIG. 5. Fiberoptic bundles contacting vessels on the surface of rib periosteum cause subperiosteal hematomas and bleeding into adjacent tissues. Surgical trauma to these vessels by blunt dissection instruments or retractors is a major cause of postoperative inflammation, discomfort, and morbidity. Strict, "no-touch" dissection techniques for periosteum and perichondrium significantly reduce morbidity.

Adjunctive Pharmacologic Agents

Specific pharmacologic agents facilitate surgical techniques and help minimize tissue trauma. Muscle relaxants in conjunction with general endotracheal anesthesia dramatically reduced the retraction forces required for optimal exposure in the subpectoral plane. The duration of action of the muscle relaxant and the timing of administration are critical for optimal results. Longer-acting muscle relaxants such as Pavulon are necessary when a surgeon is gaining experience and when operative times exceed 45 minutes. The disadvantage of longer acting muscle relaxants is that they have greater side effects and often require reversing agents that, in turn, increase narcotic effects and side effects. This increases incidence of postoperative nausea and vomiting and prolongs emergence, perioperative recovery, and time to discharge home.

When surgeon skill development allowed operative times to decrease below 45 minutes, patients in group 3 received a single dose of Nimbex, a short-acting muscle relaxant that, in most cases, was totally adequate to provide pectoralis relaxation for both pockets without requiring any reversing agents. This regimen dramatically shortened the time required for emergence in the operating room and transfer to postanesthesia care unit, with equally dramatic effects on time in the postanesthesia care unit and times to discharge.

When comparing patients in group 3 to groups 1 and 2, almost all of the data presented in part I of this study indicate that the fewer and lower doses of narcotic drugs the patient receives, and the shorter acting and smaller doses of muscle relaxant, the more rapid the recovery with fewer side effects. The maximum average dose of narcotics administered to group 3 patients was a total of 2 cc of Fentanyl.

Total doses of pharmacologic agents necessary to provide optimal anesthesia and analgesia correlates directly with surgeon skills, operative times, and degree of surgical trauma.

Dissection Techniques

On the basis of the comparisons of surgical accuracy and recovery in group 3 compared with groups 1 and 2, blunt dissection is an excessively traumatic technique of pocket development that (1) causes more bleeding, (2) compromises accuracy and control by obscuring anatomic detail, (3) increases blood in tissues, (4) wastes time required for hemostasis, (5) causes more postoperative inflammation and pain, (6) necessitates larger doses of narcotics with resultant side effects, and (7) prolongs perioperative recovery. Blunt dissection should be a totally obsolete technique when easier, better, and more efficient techniques of electrocautery dissection are readily available.

Postoperative Adjuncts

Patients understandably feel "sicker" when they have drains exiting their body and when they are wrapped in bandages, straps, or other devices postoperatively. Unencumbered by any of these devices, patients in group 3 could focus completely on returning to normal, with fewer distracting responsibilities, fewer postoperative visits, and less chance of poor patient compliance in the use of a device causing problems. By encouraging patients to shower immediately and to return to all normal activities (with the exception of aerobics) immediately and to wear or not wear a bra depending on comfort and clothing preferences only, recovery was more rapid and less complicated.

Complications

A valid, scientific comparison of complication rates from groups in this study requires a much larger case sample from groups 1 and 2 and longer term follow-up of patients in group 3. Clinical results and complication rates from patients in group 3 are reported in part I of this study.[1]

Surgeon Skills and Surgeon Education

There have been no comprehensive approaches documented in the scientific literature in the past four decades that define methods and document faster, simpler, and more trouble-free patient recovery from breast augmentation. Patient satisfaction rates with outcomes using current methods may have contributed to lack of advancements. For a procedure that is one of the most common elective procedures performed in plastic surgery, incremental improvements in patient care and recovery are overdue.

Each area of potential improvement in this study relates directly to surgeon skills. Reevaluating surgical techniques by using motion and time principles is time consuming initially but yields significant long-term dividends for surgeons and patients. Incremental improvements in care ultimately evolve from increasing surgeon skills. Surgeons are ultimately responsible for improving surgical skills. The methods reported in this study provide excellent opportunities to improve care and recovery in breast augmentation and other surgical procedures. More importantly, surgeons can apply these methods to virtually any surgical procedure to establish detailed scripts that are potentially invaluable to improved surgical care and surgeon education. Detailed analyses and scripts developed by experienced surgeons can be sequentially revised and improved, providing a consistent, new level for surgical education of residents and practicing surgeons. The detailed information in the scripts can be easily formatted for on-line availability in a variety of formats and transferred to a wide variety of media formats for resident and continuing surgeon education and reference.

Essentials for a 24-Hour Return to Normal Activity

Regardless of the incision, pocket location, or implant type a surgeon prefers, the following principles derived from this experience can help deliver state-beyond-the-art return to normal activities within 24 hours of breast augmentation:

1. Optimize patient education to provide maximum information about all alternatives, and provide each patient with a full range of choices.
2. Quantify each patient's individual tissue characteristics by using specific measurements. Reconcile patient wishes with patient tissue characteristics.
3. Finalize patient and surgeon choices on the basis of each patient's individual tissue characteristics, and document those choices in detailed, staged informed consent documents. Optimal choices

minimize long-term tradeoffs and minimize risks of reoperations.

4. Finalize all planning and implant selection preoperatively. Optimize preoperative planning and implant selection to minimize unnecessary decisions and time waste intraoperatively.
5. Ensure optimal surgical instrumentation to decrease trauma and bleeding and to optimize efficiency.
6. Implement optimal general anesthetic techniques that integrate use of short-acting muscle relaxants for subpectoral pocket dissection.
7. Eliminate any form of blunt dissection or sharp instrument dissection. Perform all pocket dissection under direct vision with monopolar electrocautery forceps or an alternative instrument that has equal efficiency to optimize prospective hemostasis.
8. Use prospective hemostasis techniques to totally eliminate even minor bleeding and to reduce even minor amounts of blood in tissues adjacent to the pocket to less than 1 cc.
9. Adopt strict, no-touch techniques for rib periosteum or perichondrium.
10. Eliminate unnecessary and undesirable adjunctive procedures or devices (drains, bandages, straps, special bras) that prolong recovery and potentially increase risks.
11. Provide detailed postoperative instructions and support during the first 24 hours postoperatively to allay patient fears and encourage compliance with instructions.

John B. Tebbetts, M.D.
2801 Lemmon Avenue, West Suite 300
Dallas, Texas 75204
jbt@plastic-surgery.com

REFERENCES

1. Tebbetts, J. B. Achieving a predictable 24-hour recovery following breast augmentation: Part I. Refining practices using motion and time study principles. *Plast. Reconstr. Surg.* 109: 273, 2002.
2. Tebbetts, J. B., and Tebbetts, T. B. *The Best Breast: The Ultimate Discriminating Woman's Guide to Breast Augmentation.* Dallas: CosmetXpertise, 1999.
3. Tebbetts, J. B. Breast implant selection based on patient tissue characteristics and implant-soft tissue dynamics. *Plast. Reconstr. Surg.* Accepted for publication.
4. Tebbetts, J. B. A staged, integrated approach to patient education, informed consent and accountability in breast augmentation. *Plast. Reconstr. Surg.* Submitted for publication.

5 Tebbetts, J. B. Dual plane breast augmentation: Optimizing implant-soft tissue relationships in a wide range of breast types. *Plast. Reconstr. Surg.* 107: 1255, 2001.

6. Tebbetts, J. B. *Dimensional Augmentation Mammaplasty Using the BioDimensional™ System.* Santa Barbara: McGhan Medical Corporation, 1994. Pp. 1–90.
7. Tebbetts, J. B. Patient evaluation, operative planning, and surgical techniques to increase control and decrease morbidity and reoperations in breast augmentation. *Clin. Plast. Surg.* 28: 501, 2001.