

Surgical Timing and the Menstrual Cycle Affect Wound Healing in Young Breast Reduction Patients

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Background: Young female subjects are known to have the highest baseline menstrual hormone levels of any female age group. Studies have found an association between hormone levels and wound healing. This has been researched in the orthopedic, gynecologic, and dermatologic literature, and more recently, in young patients undergoing augmentation mammoplasty. The purpose of this study was to determine whether the timing of surgery relative to the menstrual cycle plays a role in surgical complications following bilateral reduction mammoplasty.

Methods: All female patients aged 25 years or younger with a documented last menstrual cycle undergoing a bilateral reduction mammoplasty from 2005 to 2013 were reviewed. Surgical timing and postoperative complications relative to the last menstrual cycle were recorded. The preovulatory phase referred to days 1 to 14 after the patient's last menstrual cycle, whereas the postovulatory phase referred to days 15 to 28.

Results: Forty-nine patients met inclusion criteria. Undergoing bilateral reduction mammoplasty during the postovulatory phase was associated with development of wound dehiscence and hypertrophic scarring ($p < 0.005$), which were the most common postoperative complications. Surgery in the preovulatory or postovulatory phase did not affect hematoma, seroma, wound infection, or nipple-areolar complex necrosis rates ($p > 0.05$). Age, race/ethnicity, body mass index, large resection mass, and medical comorbidities did not affect wound dehiscence or scar hypertrophy rates ($p > 0.05$).

Conclusions: Young patients undergoing bilateral reduction mammoplasty during the postovulatory phase of the menstrual cycle have an increased risk of wound healing issues and poor scarring. This may be attributable to hormonal fluxes occurring during this phase and the already high hormone levels in this population. (*Plast. Reconstr. Surg.* 137: 406, 2016.)

Bilateral reduction mammoplasty is a common procedure performed in the United States, with 25 percent of these occurring in women younger than 35 years.¹ Most of these women undergo the procedure for relief of symptomatic macromastia, which manifests as neck

and back pain, shoulder grooving, intertrigo, and poor self-image.^{2,3} A majority of women with macromastia develop symptoms early on in adolescence shortly after puberty, leading them to undergo surgery during their late teenage years and second decade of life.^{4,5} There are numerous studies showing the physiologic and emotional

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benefits of bilateral reduction mammoplasty. It has proven to be a safe and effective procedure for these patients.⁶

Women undergoing bilateral reduction mammoplasty during their late teens and early twenties have been shown to have female hormone levels that are at their lifetime peak. Specifically, baseline estrogen and progesterone levels are highest in this population and begin to decline as a woman approaches her thirties.⁷ During the menstrual cycle, these hormone levels fluctuate, allowing for ovulation and other physiologic changes. Specifically, a rise in estrogen during the preovulatory phase causes ovulation, whereas progesterone is the predominant hormone of the postovulatory phase.⁸

The effects of menstrual hormones on wound healing, scarring, and other postoperative factors are not well studied in the plastic surgery literature. Our group recently published a study showing that all patients younger than 25 years who underwent augmentation mammoplasty during the postovulatory phase of the menstrual cycle developed striae distensae.⁹ Given the paucity of data in the plastic surgery literature on the effects of menstrual hormones on plastic surgery patients, a study was designed to evaluate young female patients undergoing bilateral reduction mammoplasty for symptomatic macromastia, a commonly performed procedure in our practice. The purpose of this study was to determine whether the timing of bilateral reduction mammoplasty relative to the menstrual cycle plays a role in wound healing and postsurgical complications in this group.

PATIENTS AND METHODS

An institutional review board–approved retrospective chart review was performed for patients undergoing bilateral reduction mammoplasty from 2005 to 2013. All procedures were performed at the University of Texas Medical Branch and the Houston Plastic and Reconstructive Surgery Practice.

The study population included women aged 25 years or younger with a last menstrual period recorded in the medical record. All patients underwent either a Wise pattern inferior pedicle bilateral reduction mammoplasty or amputation style free nipple graft bilateral reduction mammoplasty. Exclusion criteria included last menstrual period more than 30 days before surgery, concurrent hormone therapy such as oral contraceptive pills, tobacco use, and insufficient documentation

in the medical record. All cases included had preoperative and postoperative photography and detailed documentation in the electronic medical record. Patient charts were reviewed for demographic data such as age, race, body mass index, and medical comorbidities.

Records, both written and photographic, were also reviewed for postoperative complications, including wound dehiscence, hypertrophic scarring, hematoma, seroma, infection, and nipple-areola complex necrosis. Striae distensae were not evaluated postoperatively because, on review, all patients with macromastia exhibited striae preoperatively. Dehiscence was described as a postsurgical open wound on the breast documented to be at least 1 cm in size and requiring local wound care or surgical intervention. Hypertrophic scarring was described as a raised, pruritic, painful scar outside the norm of scar maturation treated with steroid therapy, scar revision, or a strict protocol of silicone and massage requiring follow-up. Hematoma and seroma were defined as fluid collections requiring surgical or radiology-guided drainage. Infection was described as cellulitis or abscess requiring antibiotics and/or surgical intervention. Nipple-areola complex necrosis was described as impending nipple-areola complex loss requiring suture release, operative intervention, or reconstructive procedures.

Surgical timing and postoperative complications relative to the patient's last menstrual cycle were then reviewed. The patients were divided into two groups. The first group included patients who underwent bilateral reduction mammoplasty during the preovulatory phase of their cycle, whereas the second group included patients who underwent surgery during the postovulatory phase. The preovulatory phase referred to days 1 to 14, with day 1 being the first day of the patient's last menstrual period. The postovulatory phase referred to days 15 to 28 of the cycle. The patients were placed into these groups based on how many days had passed since their last menstrual period and the day of surgery.

The database was constructed and statistical analysis performed. The chi-square test was used to determine a correlation between the phase of the menstrual cycle and individual postoperative complications. The relationship between age, body mass index, ethnicity, medical comorbidities, and postoperative complications relative to the menstrual cycle were evaluated with multivariate analysis. A value of $p < 0.05$ was considered statistically significant.

RESULTS

A total of 561 breast reductions were performed at our institution from 2005 to 2013. Of these, 49 patients met our inclusion criteria. The average age of patients was 19.9 years, ranging from 14 to 25 years. Mean follow-up time was 8 months, ranging from 4 to 22 months. Forty-three percent of patients were white, 12 percent were Hispanic/Latino, and 45 percent were African American.

The most common medical comorbidity was asthma (16 percent of patients). Other comorbidities were less frequent and included scoliosis, attention deficit hyperactivity disorder, migraine, mitral valve prolapse, hypertension, and depression (1 percent each). None of the patients were on steroids or any other immune-modulating medication. The average body mass index of our patients was 31 kg/m², ranging from 24 to 46 kg/m². Thirty-seven percent of patients had a body mass index less than 30, 51 percent had a body mass index between 30 and 40, and 12 percent had a body mass index greater than 40 kg/m².

Half of our patients underwent bilateral reduction mammoplasty during the preovulatory phase of their menstrual cycle, and the other half underwent bilateral reduction mammoplasty during the postovulatory phase. The most common postoperative complications were wound dehiscence and scar hypertrophy, occurring in 20 and 11 of our 49 patients, respectively. There was one case of hematoma, two cases of seroma and infection each, and no cases of nipple-areola complex necrosis (Fig. 1). Of the 20 patients who developed wound dehiscence, 85 percent

had undergone bilateral reduction mammoplasty during the postovulatory phase. Of the 11 who developed hypertrophic scarring, 91 percent had undergone surgery during the postovulatory phase of their cycle (Fig. 2). Undergoing surgery during the postovulatory phase of the menstrual cycle was associated with an increased incidence of wound dehiscence and hypertrophic scarring ($p < 0.005$). When looking at whether wound dehiscence was associated with hypertrophic scarring, there was no correlation between the two. Three of our patients had both wound dehiscence and hypertrophic scarring ($p > 0.05$).

The mean resection mass was 882 g (range, 200 to 2525 g) from the right breast and 880 g (range, 180 to 2465 g) from the left breast. Resections were grouped as small (<500 g), moderate (500 to 1000 g), and large (>1000 g). Fifty-one percent of patients underwent a moderate reduction versus 24 percent who underwent a small and a large reduction, respectively. Of the 20 patients who developed wound dehiscence, 20 percent underwent small resections, 55 percent underwent moderate resections, and 25 percent underwent large resections. Of the 11 patients with scar hypertrophy, 27 percent underwent small resections, 55 percent underwent moderate resections, and 18 percent underwent large resections.

Surgical timing relative to the menstrual cycle did not affect other postoperative complications, including hematoma, seroma, and wound infection (Table 1) ($p > 0.05$). Age, race/ethnicity, body mass index, large resection mass, and medical history did not affect postoperative complication

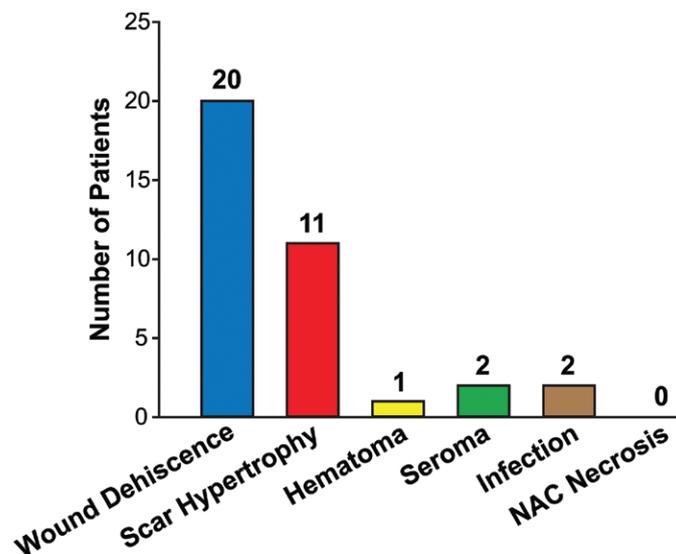


Fig. 1. Postsurgical complications. NAC, nipple-areola complex.

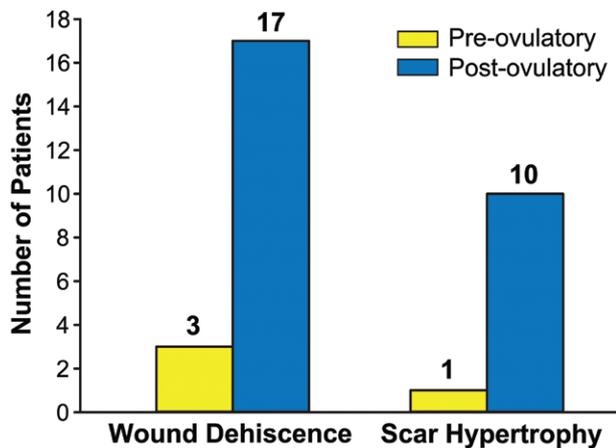


Fig. 2. Most common postsurgical complications and phase of menstrual cycle at the time of surgery.

rates ($p > 0.05$). Race/ethnicity did not affect postoperative wound dehiscence or scar hypertrophy rates (Table 2) ($p > 0.05$).

DISCUSSION

In our patient population, undergoing bilateral reduction mammoplasty during the postovulatory phase of the menstrual cycle was associated with an increased risk of wound healing issues and hypertrophic scarring. The postovulatory phase of the menstrual cycle consists of a decline in estrogen levels and a slow, steady rise in progesterone. Hormonal fluxes in the postovulatory phase may lead to changes in wound healing, scarring, and overall skin quality.

In vitro studies have shown that cultured skin cells are particularly sensitive to changes in estrogen and progesterone, which then affect wound repair, collagen synthesis, and extracellular matrix composition. Skin with striae distensae has higher levels of progesterone receptors than normal skin, making the skin especially vulnerable to the effects of progesterone and subsequent development of striae.¹⁰

The effects of the menstrual cycle have been studied in multiple other specialties. There are numerous studies in the orthopedic literature supporting increased rates of ligamentous injuries during the preovulatory phase of the menstrual cycle of young women.¹¹⁻¹³ Some postulate that the ligaments

Table 1. Least Common Postsurgical Complications and Phase of Menstrual Cycle at the Time of Surgery

Menstrual Cycle	Hematoma	Seroma	Infection	NAC Necrosis
Preovulatory	0	1	0	0
Postovulatory	1	1	2	0

NAC, nipple-areola complex.

are stiffer and more likely to tear because of preovulatory hormonal changes.¹⁴ The dermatologic literature reports increased autoimmune and dermatoses flares during the postovulatory phase of the menstrual cycle.^{15,16} Furthermore, the obstetrics literature demonstrates that younger women are more likely to develop striae gravidum because of higher baseline hormone levels and fluxes during pregnancy.¹⁷

Limitations of our study include not only its retrospective nature, but also the fact that wound healing may be attributed to other factors, including those inherent in the patient and in the surgical technique. We excluded patients on oral contraceptive pills and active smokers; given the age of our patients, we expected them to be relatively healthy. We attempted to account for various factors, including age, body mass index, large resection mass, and race/ethnicity, and found no correlation between these and postoperative complications. Although the Cunningham study also showed that age and body mass index were not associated with increased complications, it did show increased complication rates with increased resection mass, which contrasts with our results.⁶ Although surgical technique was performed in the standard fashion, retrospectively assessing viability of breast flaps after dissection and tension after wound closure would be difficult to perform. Given our small sample size, the effects of the menstrual cycle on the other postoperative complications were not significant.

CONCLUSIONS

To our knowledge, this is the first study in the plastic surgery literature to demonstrate how wound healing is affected by the menstrual cycle. In this article, we show significantly increased wound healing issues and hypertrophic scarring in young women who had surgery after ovulation.

Table 2. Race/Ethnicity and Incidence of Wound Dehiscence and Scar Hypertrophy

Race/Ethnicity	No. of Patients	Dehiscence	Hypertrophy	Preovulatory	Postovulatory
White	21	10	5	10	11
Hispanic	6	2	2	3	3
African American	22	8	4	12	10

We hope that a prospective study detailing these findings will help us better understand how female hormones affect healing, patient outcomes, and ultimately patient satisfaction.

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