

## ADVANCES IN BREAST RECONSTRUCTION AFTER LUMPECTOMY AND MASTECTOMY

**Breast cancer has been described as far back as 1600 B.C.** in the papyrus writings of the ancient Egyptians. Galen later theorized that the cancer was due to a collection “of black bile” inside the breast. Virchow proposed this so-called “tumor” originated from the epithelium and spread outward in all directions.

**The American surgeon William Halsted** supported the theory that breast cancer began as a “regional” phenomenon, before it spread distantly. And in 1882 he first performed the first Radical Mastectomy, which involved removal of the entire breast, the lymph nodes in the area, and the underlying pectoralis chest wall muscles. As you can imagine, this led to a very disfiguring appearance, but Halsted was able to achieve a 5-year cure rate of 40% which was unheard of at the time.

**Because of Halsted’s principles,** breast reconstruction was really never an option since it was considered a “violation of the local control of the disease.” Halsted warned surgeons not to perform plastic operations at the mastectomy site because he believed it could hide local recurrence and “may sacrifice his patient to disease.”

Therefore, many of the initial attempts at breast reconstruction took place in Europe.

### EARLY BREAST RECONSTRUCTION

**Breast reconstruction itself dates back to the 1800s,** with the initial attempt taking place in 1895 by the German surgeon, Vincent Czerny. He reported the case of a 41 year old singer who required a mastectomy for a fibroadenoma and chronic infections. He reported that “since both breasts were very well developed” she would have “an unpleasant asymmetry” after removal of one breast, which would have “hindered her stage activity”. Luckily, the patient had a benign fatty tumor on her back “the size of a fist”, which he decided to remove at the time of her mastectomy and place in the chest wall to recreate a breast mound. At 6 months follow-up, the breast was firm and somewhat smaller, but without tenderness and nevertheless represented the first credited breast reconstruction.

In 1906, **Ombredanne** from France performed a flap reconstruction using the pectoralis minor muscle to create a breast mound. This was distinct from the other plastic surgery operations being performed at that time, in that his colleagues were attempting to replace the skin defects created by mastectomy, but never the shape or projection of the breast itself as that was considered a “luxury operation with limited indications.”

That same year, Italian surgeon **Tanzini** encountered difficulty closing large wounds after radical mastectomies. Out of necessity, He developed a flap of skin and underlying latissimus dorsi muscle from the back, which he rotated into the mastectomy defect. As breast surgery became more radical, reconstructive surgeons became more innovative and in 1912, Professor Stefano d’Este introduced the

latissimus myocutaneous flap utilizing the back side latissimus dorsi muscle and overlying skin paddle for reconstruction of the breast.

**But all these techniques were soon forgotten**, and only an occasional reconstruction was attempted for the next 60 years because of Halsted's principles.

**It was not until the latter half of the 20<sup>th</sup> century** and the rise of the women's movement that radical mastectomy procedures were questioned and the modified radical mastectomy was developed and perfected. The modified radical mastectomy involved removing the breast tissue along with some lymph nodes while preserving the chest wall muscles.

**In 1976, the NSABP** (National Surgical Adjuvant Breast Project) began a randomized trial comparing lumpectomy, lymph node dissection with and without radiation vs. mastectomy with lymph node dissection. The Five year follow up results were published in the New England Journal of Medicine in 1985 and indicated that treatment by lumpectomy, with or without breast irradiation, resulted in disease-free, distant-disease-free, and overall survival at five years that was no worse than that after total mastectomy. The addition of radiation was found to decrease local recurrence.

**But for those women who were not candidates for lumpectomy** and still required mastectomy, the pendulum began to swing towards more conservative excisions. In 1991, the term skin sparing mastectomy was introduced. The procedure removes the breast and nipple-areola complex but preserved the skin envelope. Several studies in large centers supported the efficacy of the skin-sparing mastectomy as a cancer operation demonstrating similar recurrence rates as that of conventional mastectomies. The use of the skin-sparing technique for immediate breast reconstruction ultimately led to reduced operating times, fewer revisional surgeries, and greater patient satisfaction.

With a new found focus on tissue preservation in breast cancer surgery, breast reconstruction was poised to take off.

It began during WWII when the Dow Corning Chemical Company created commercial uses for silicone. In 1962, two cowboys from Texas, Drs. Thomas Cronin and Frank Gerow, working with Dow, introduced the silicone gel breast implant. The implant was made of a silicone rubber sac filled with a thick, viscous gooey silicone gel. Dow Corning began commercial marketing of the silicone implant in 1964 for use in cosmetic and reconstructive breast surgery. The basic design remained unchanged for the next 30 years. A French surgeon later developed the first saline implant in 1965, but it was considered inferior by the medical community, since it was prone to spontaneous deflation, and by women, who felt that it lacked the natural feel associated with silicone gel implants.

**At this point, breast reconstruction** in the form of implant placement occurred as a **delayed procedure** weeks to months after the mastectomy had healed. This delayed technique dominated until a case of an immediate reconstruction was reported in 1971 when Snyderman and Guthrie placed a silicone breast implant under the remaining chest wall skin immediately following a mastectomy.

**In 1982**, in an effort to improve results by recreating the skin envelope, Radovan described a technique to gradually expand the skin which was lost from mastectomies. This sparked the use of tissue expanders and a staged approach for breast reconstruction. During the first surgery, the mastectomy was performed followed by placement of a tissue expander. Then after the skin and tissue was expanded to an adequate size, the tissue expander was exchanged for a permanent implant at a 2<sup>nd</sup> surgery.

**By the late 1980's, over a million women had silicone implants.** Unfortunately, the early generation silicone devices began leaking and the liquid gel in the tissues led to breast scarring and painful deformities. Allegations that silicone breast implants could cause cancer or autoimmune diseases were made by health care advocacy groups, fueling mass litigation. In 1992, the FDA banned silicone implants and Dow Corning went out of business.

Between 1992 and 2006 saline filled breast implants were the only fully-approved type of implant available in the United States. Patient satisfaction was, good, but interest in silicone implants continued. During this period large scale studies of the health effects of silicone implants were performed. Numerous reports demonstrated that there was no link between silicone breast implants and illnesses like cancer or lupus. This led to the national adjunct study which was commissioned to prospectively analyze the outcomes of women using silicone implants for reconstruction. Plastic surgeons worked with the two remaining U.S. implant manufacturers to report data in an FDA approved protocol.

Finally, in November of 2006, the FDA reversed its ban on silicone-filled breast implants stating that they were “safe and effective.” Currently silicone gel implants are widely used for both cosmetic breast augmentation and breast cancer reconstruction.

**While implant reconstructions are still the most widely used technique** for breast reconstruction in the US, certain aspects of it have motivated plastic surgeons to develop and perfect other forms of reconstruction. Drawbacks of implant based reconstructions include the need for numerous office visits, the risk of deflation and need for replacement as well as results that appear round and less natural-looking and feel “cold” as compared with an autologous flap derived from the patient’s own tissues. Long term complications of implants such as capsular contracture and rippling also underscored the need to develop other means of breast reconstruction that might perhaps provide a longer lasting result.

### **The Evolution of Autogenous Tissue Reconstruction**

**Now it turns out that Atlanta is the birthplace of most of the modern autologous breast reconstruction techniques that we use today.**

The latissimus muscle flap was studied in the 1970s and by understanding the vascular connections to the skin provided by the underlying muscle, McCraw proposed using the latissimus dorsi muscle along with the overlying skin island.

In 1977, the late Dr. John Bostwick (with whom I had the pleasure of training under) elaborated on this. His experience with the latissimus dorsi flap involved the use of the muscle flap alone, the use of the

muscle with overlying fat and skin, and combining the flap with implants. His techniques consistently provided adequate skin coverage and replacement of the breast mound contour, resulting in improved breast symmetry and overall cosmetic result.

In 1982, Dr. Carl Hartrampf, of Atlanta Georgia, introduced the transverse rectus abdominus myocutaneous flap, otherwise known as the TRAM flap. Through cadaver studies, he learned that the blood supply to the skin and fat of the lower abdomen came from blood vessels from the underlying rectus muscle. He figured out that if he took the lower abdominal skin and fat along with the underlying rectus muscle providing the blood supply, he could rotate and tunnel these tissues into the breast area to create a final result that is living and durable and eliminates the need for an implant. The abdominal defect was closed much like a tummy tuck. Plastic surgeons all over the world scrambled to learn this technique.

Simultaneously in the early 1980s, various techniques for nipple reconstruction and tattooing for the areola emerged as ancillary procedures to further enhance and complete the results being achieved in breast reconstruction.

## **So where are we today?**

As I mentioned at the beginning of this talk, the evolution of breast reconstruction has paralleled the evolution of the treatment of breast cancer.

**To this day, the mastectomy technique is likely the single most influential factor in the ultimate reconstructive outcome.** We've gone from "tissue-eradicating" procedures to "tissue-sparing" ones. Because of this, the need for skin replacement has been largely reduced, excessive breast scars can be minimized and an individual's native breast skin color and texture can be maintained. And even more recently areolar-sparing and nipple sparing mastectomies have been options for women with early stage breast cancer. This trend toward more conservative mastectomy techniques which preserve greater amounts of a woman's own chest wall tissue has led to improved aesthetic outcomes in breast reconstruction.

Immediate reconstruction, in which breast reconstruction begins at the same time as the mastectomy, is now the "gold standard" for breast cancer patients. It allows breast surgeons and plastic surgeons to collaborate on both removing the cancer and reconstructing more natural-looking breasts.

**The ideal reconstructive technique** should be safe, reliable, and reproducible, with limited or no resultant long-term complications. Such a technique would replace the breast with tissue of similar quality, producing an aesthetic result indistinguishable from the natural breast. The TRAM flap was a huge step towards this goal as it provided soft living tissue that felt like a natural breast. However, over time, the magnitude of the donor-site complications following a TRAM flap became more apparent with patients developing abdominal wall weakness, bulges, and difficult to repair hernias. As plastic surgeons, we are always looking for better ways to do things and so we looked for means of transferring the same lower abdominal tissue while leaving the muscles intact to maintain abdominal form and function.

**Thus, perforator flaps were born.** A perforator flap is based on blood vessels that come through or “perforate” the muscle below it. The DIEP (deep inferior epigastric perforator) flap is a technique that is both an evolution and a refinement of TRAM flap. While the TRAM flap takes the muscle along with the overlying fat and rotates it into the breast, the DIEP flap does so without sacrificing the muscle.

The DIEP flap relies upon the small vessels that come through the rectus muscles. These vessels are carefully dissected out through the muscle by spreading apart the muscle fibers and traced back to the main blood vessel from which they arise. This main artery and vein are divided in the abdomen and then reconnected to an artery and vein in the chest to create a channel for blood flow into and out of the newly transplanted abdominal tissue.

The DIEP flap was first described in 1991 by a Japanese microsurgeon. Koshima described isolating skin and the subcutaneous tissue based upon blood vessels that travel through the rectus abdominus muscle. He was able to transfer this flesh to another body area (not breast) utilizing microsurgery and without sacrifice of the rectus abdominus muscle. -But,-it wasn't until 1993, when Dr. Phillip Blondeel in Belgium and 1994 when Dr. Robert Allen in the US reported the use of this flap for breast reconstruction and demonstrated what an advantage the DIEP was over the TRAM flap by minimizing abdominal donor site complications. Drs. Blondeel and Allen convinced a number of microsurgeons that the extra time, care and skill needed for this surgery was well worth the effort.

While the DIEP flap is the **workhorse** and gold standard perforator flap used in breast reconstruction, other perforator flaps being performed today utilize tissue from the buttock, inner and outer thighs. By obviating the need to harvest muscle, these perforator procedures have allowed women to undergo breast reconstruction with an easier recovery and fewer donor site complications.

**For women who desire implant based reconstruction,** the most recent FDA approved breast implants are termed the “gummy bear” implants. These are tear-drop shaped silicone implants which better simulate the natural shape of the breast. This is generally a two stage procedure with an expander followed by implant placement, though with the emergence of skin sparing mastectomies a growing number of patients are able to undergo a single stage operation consisting of immediate placement of a permanent implant at the time of the mastectomy. The advantages of these implants are that they provide a good natural shape to the breast, and there have been less reports of rippling. However, in order to keep its shape, the gel is more cohesive and therefore feels firmer to touch than their round silicone implant counterparts.

**The ultimate in native tissue preservation is lumpectomy surgery.** The majority of these patients will not require any reconstruction though a subset of patients may develop asymmetry or deformity post lumpectomy and radiation therapy.

What is a lumpectomy breast reconstruction? Until recently, when people thought of breast reconstruction, they thought of creating an entire breast after mastectomy. The reconstruction of lumpectomy defects is frequently referred to as oncoplastic surgery. Lumpectomy defects can range in severity from minor depressions at the lumpectomy site to notable asymmetries apparent even in clothing. For these patients, we've got options!

1. For smaller defects there is Fat grafting. In this procedure, fat cells are harvested from one part of the body-such as the abdomen or thighs-and injected into the area that needs more volume.
2. For larger defects, the Latissimus flap or partial latissimus flap can be used alone without an implant to replace deficient tissue volume. Alternatively, the opposite breast can be reduced or lifted to match the lumpectomy breast.
3. For large breasted patients who desire lumpectomy and smaller/perkier breasts, the plastic surgeon and breast surgeon can work in tandem to simultaneously excise the tumor and reduce/lift the breast. This procedure is termed an oncoplastic reduction.

### **WHAT IF YOU JUST DON'T WANT RECONSTRUCTION?**

Generally, healthy patients may be considered candidates for all reconstructive options, while those with multiple medical problems may be unable to tolerate lengthy procedures. Some women also find the thought of reconstruction overwhelming at the time of receiving a cancer diagnosis. In the spirit of breast reconstruction innovation here in Atlanta, GA, Dr. Heather Richardson and I designed the Goldilocks mastectomy for these very patients.

I think everyone here is familiar with Goldilocks and the 3 bears. She didn't want anything too hot, or too cold; she didn't want anything too hard or too soft. Instead, she opted for the option that was a compromise of both extremes.

### **GOLDILOCKS**

Termed the Goldilocks because it sits in the middle of the spectrum from formal reconstruction to amputation mastectomy, **it is no different from any other skin sparing mastectomy in that breast tissue is removed while preserving healthy fatty tissue and skin.** Ordinarily, this skin/fat envelope is filled with an expander, implant or flap to create a breast. In a goldilocks mastectomy, the mastectomy flap tissues themselves are rearranged and shaped into the semblance of a breast mound. The result is similar to an extreme breast reduction, with the final size being dependent on the size of the original breast. A single stage procedure with minimal recovery time, it is an alternative for women who do not desire formal reconstruction, yet do not want to have the amputated appearance of a conventional mastectomy.

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### **IN SUMMARY**

About 1 in 8 U.S. women will develop invasive breast cancer over the course of her lifetime. Breast reconstructive techniques have evolved a great deal over the past several decades, and we've certainly come a long ways from transplanting a lipoma into a breast.

The benefits of breast reconstruction are well described. It enables women to complete the healing process by repairing the otherwise constant physical reminder of their diagnosis and treatment. As a result, breast reconstruction now occupies an important place in the overall modern treatment planning for women who face mastectomy.

With improvements including smaller scars, shorter recovery times and being able to keep as much of one's own breast skin as possible, women facing mastectomies can comfortably realize that she can exist with a recreated breast that looks and feels very natural through any of a number of options tailored to the individual's needs. This could be considered the golden age of breast cancer reconstruction. The only downside is trying to decide which procedure you want!

Thank you for your attention!