

Possible Future Development of Implants and Breast Augmentation

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KEYWORDS

- Breast • Technology • Augmentation
- Implants • Fat • ADM

Following the introduction of the silicone gel prosthesis in 1962,¹ breast augmentation has become one of the most frequently performed operations in plastic surgery.² It is estimated that more than 1% of the adult female population in the United States (between 1 and 2 million) has undergone breast augmentation.³

Czerny⁴ reported the first augmentation mammaplasty, in which he transferred a lipoma to the breast, in 1895. Longacre⁵ attempted autogenous “flap” augmentations in the 1950s, and the use of various injectable substances such as petroleum jelly, beeswax, shellac, and epoxy resin soon followed.⁶ Uchida⁷ reported the use of injectable silicone in 1961. Solid materials implanted in the 1950s and early 1960s included polyurethane, Teflon, and polyvinyl alcohol formaldehyde (the Ivalon sponge).⁶

On the other hand, in the early twentieth century, Lexer⁸ described placing a fat graft as large as two fists into a breast, with an excellent result 3 years later. Others have described transplanting fat to the breast; however, none of the techniques ever became widely used. In the early 1980s, liposuction provided us with a new potential source of autologous tissue for breast augmentation, and surgeons soon described placement of the fatty tissue removed with liposuction into the breast.^{9–12}

After Mel Bircoll^{9,10} described his fat grafting at the California Society of Plastic Surgeons in 1985, a heated discussion over the safety of fat grafting

to the breast ensued at regional and national meetings.

BREAST IMPLANTS

The modern era of breast augmentation began in 1962 with the introduction of silicone gel breast implants.¹ The silicone gel implants commercially available in the United States today are a refined and safer device than their predecessors. The Cronin and Gerow¹ mammary implant of the 1960s, which was manufactured by Dow Corning, was composed of a viscous silicone gel contained within a thick silicone shell in the shape of a teardrop. These early devices had such a high incidence of capsular contracture that a new generation of silicone implants was developed by various manufacturers in the mid to late 1970s in an attempt to produce a more natural result. The third generation of smooth-surfaced silicone implants, developed in the early to mid 1980s, focused on improving the strength and integrity of the silicone shell as well as on minimizing the silicone bleed phenomenon.^{13,14} This generation of implants was characterized by two layers of “high-performance” elastomer with a thin fluorosilicone “barrier coat” in between (produced by McGhan Medical, Heyer-Schulte, Dow Corning, and Cox-Uphoff). Third-generation silicone gel implants with the application of a textured surface can be considered fourth-generation devices,

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and cohesive silicone gel-filled implants can be considered fifth-generation devices.

TECHNOLOGICALLY ADVANCED BREAST IMPLANTS

Cohesion

All silicone gel implants are cross-linked to maintain a gel consistency, and thus all silicone gel has cohesive properties. As the cross-linking is increased, the consistency or firmness of the “liquid-feeling” gel changes to that of a soft cheese. The enhanced cohesive nature of these implants makes them “form stable.” This refers to the implant’s maintaining its shape in all positions (shape maintenance). These implants are designed in various anatomic dimensions in addition to round shapes and are collectively referred to as cohesive silicone gel implants. These form-stable implants are currently popular worldwide and are undergoing Food and Drug Administration (FDA)-approved clinical trials in the United States.¹⁵

Anatomic

The original Cronin and Gerow silicone gel implants had a teardrop shape, as did a number of the early saline- and gel-filled devices. Problems with capsular contracture, however, led manufacturers to design round, smooth-surfaced low-profile implants, which would move within their surgical pockets. These round, smooth designs dominated the market for nearly 20 years. Only when the phenomenon of immobility with softness was appreciated was the creation of anatomic devices clinically appropriate.^{16–35} The polyurethane Optimum and Replicon devices (no longer available) were early-generation anatomic-shaped implants popular in the 1980s.^{36,37} The adherence of the polyurethane surface, in fact, lent itself to the “stacking” of these implants, one on top of another, to produce an anatomic shape with enhanced projection.³²

The tissue adherence observed with tissue expanders that had the Biocell surface led McGhan to develop anatomically shaped expanders and subsequently an internally stacked style 153 gel anatomic-shaped implant.^{20,32,35} Favorable clinical experience and advanced product design led to a matrix of variable height-to-width ratio anatomic expanders and implants, the Style 133 expanders and Style 410 Matrix cohesive implants. The latter enjoy widespread international use in aesthetic surgery³⁸ and have completed their initial FDA clinical Investigative Device Exemption study in the United States, awaiting longer follow-up.

Silimed (Brazil) markets polyurethane-covered cohesive silicone gel implants in anatomic shapes.¹⁶ These devices also enjoy international popularity, but to date, no clinical investigative studies have taken place in the United States.

Mentor introduced a midheight Siltex anatomic-shaped tissue expander in 1997 and other height options in 2003. In the fall of 2002, an Investigative Device Exemption study on a midheight anatomic cohesive gel implant was initiated. These “contour”-shaped devices are covered with the Siltex texture. Because tissue adherence does not generally occur, the pocket must be exact and only minimally larger than the footprint of the reduced height device to minimize the possibility of implant rotation.^{39,40}

Anatomic-shaped saline inflatable implants are available in the United States manufactured by both Mentor and Allergan (INAMED), and there is debate among plastic surgeons about the merit of each relative to the resultant breast form.^{41–46} This debate seems confined to saline-filled implants alone, as virtually all tissue expanders marketed for breast reconstruction in the United States are textured and anatomically shaped. It is predicted that once cohesive gel anatomic implants and other gel implants are available in the United States, the issue will be of less concern as evidenced by surgeons’ preferences worldwide.

FAT GRAFTING

As with any surgical procedure, the technique used, the execution of the technique, and the experience of the surgeon affect the outcome. The technique must maximize survival of the fatty tissue, not only by minimizing trauma during harvesting and refinement but also by placing the living fatty tissue in small aliquots rather than large clumps. Minimizing the amount of graft with each pass of the cannula will maximize the surface area of contact between the grafted fat and the recipient tissue. The proximity of the newly grafted fat to a blood supply encourages survival and minimizes the potential for fat necrosis and later calcification.⁴⁷

In contrast, when fat is placed into the recipient site in large clumps, some of the fat cells may be too far from a blood supply, leading to fat necrosis, causing not only lumps and calcifications, but also the formation of liponecrotic cysts in the breasts.^{48–51} Therefore, transplanting fat in large clumps should be avoided.

Cytokines

Tissue engineering is the science of generating tissue by using the principles of molecular biology

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