Breast implants are typically placed for cosmetic or reconstructive purposes, and are recognized to have a substantial impact on aesthetics and quality of life. In addition, the presence of a breast implant on the chest wall has a potential benefit of force diffusion or force absorption in traumatic injury. This article reports a series of three patients with preexisting breast implants who suffered penetrating chest trauma. In each case, the presence of a breast implant was potentially lifesaving. We describe the cases in detail, provide a conceptual discussion, and discuss directions for future research.

Level of Evidence: 5

Breast implants are placed for cosmetic or reconstructive purposes. In combination, breast augmentation and breast reconstruction with implants are among the most common procedures performed by plastic and reconstructive surgeons. Specifically, in 2017 alone, over 330,000 women had cosmetic breast augmentation and an additional 87,000 women had breast implants placed for reconstruction in the United States. Some estimate that over 5 million women in the United States currently have breast implants.

Both breast augmentation and breast reconstruction with implants have substantial and significant impact on patient-reported quality of life and aesthetics. Recent data support that rare and potentially life-threatening complications can occur with implants. Specifically, anaplastic large cell lymphoma (ALCL), a low-grade malignancy, can occur years after the placement of the breast implant—with a risk estimate of 82 patients per million being affected. Among the entire United States population with breast implants, 230 ALCL cases have been reported to the Patient Registry and Outcomes for breast Implants and anaplastic Large cell lymphoma Epidemiology (PROFILE) registry, jointly sponsored by the American Society of Plastic Surgeons, Plastic Surgery Foundation, and the United States Food and Drug Administration, to date. Although ALCL is incredibly rare, surgeons routinely discuss the risk

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with patients. Conversely, and probably due to a paucity of data, surgeons do not routinely discuss rare potential benefits of implants, separate from aesthetics and quality of life, with patients.

The goal of this article is to serve as an update to and expansion upon prior work, previously performed in isolation by the authors. This article demonstrates three cases, showing that the presence of a breast implant was potentially life-saving. Plastic surgeons can consider the larger questions of whether breast implants might have unexpected or unanticipated protective effects. Although the article discusses penetrating trauma, implant-mediated protection against blunt traumatic injuries via force dispersion would be similarly intriguing, and more likely to be experienced than penetrating injuries. A conceptual discussion of breast implants in blunt injury is also provided.

CASE DESCRIPTION

Case I: Firearm Injury (Shotgun, Bird Shot)

The authors report and update a previously published case in which a 59-year-old woman presented to the Emergency Department at Vanderbilt University Medical Center having sustained a non–self-inflicted gunshot injury in September 2013.7 The patient’s past medical history was significant for previous subpectoral breast augmentation with 659 cc Allergan Natrelle style smooth round silicone breast implants less than 1 year prior to injury. The patient sustained multiple wounds of her right chest, axilla, shoulder, abdomen, and right lower extremity as a result of being shot with a shotgun twice through a door with birdshot. She presented in stable condition and with normal vital signs. She denied shortness of breath and only complained of pain in the areas of the shotgun blast injury.

The patient’s workup began with an upright chest radiograph, which showed scattered pellet foreign bodies but no pneumothorax or free air beneath the diaphragm. The computerized tomogram (CT) that followed showed no pneumothorax but demonstrated multiple pellet tracts with subcutaneous air and multiple pellets contained within the silicone breast implant (Figure 1). However, it also showed some pellets within the mediastinum near the sternum and overlying the pericardium. These findings prompted the trauma service to take the patient to the operating room for a pericardial window procedure. The results of the operation were negative, so she was kept overnight for observation and discharged home the following day.

An interval time passed without complication for the patient, who then followed up as an outpatient with her original surgeon. She subsequently underwent implant removal and replacement, at which time the right implant was found to be laden with shotgun pellets. The right implant pocket was entered through her former augmentation scar. The implant was noted to have been penetrated with multiple projectiles measuring about 2-3 mm in diameter. Most of the projectiles were both suspended in the gel of the implant, but a few were free within the implant pocket. Lighted retractor was used to examine for projectiles entrapped in the peri-implant capsule. She was irrigated and a new 659 Allergan Natrelle implant was returned to the pocket. A similar procedure was carried out on the left breast where no projectiles were noted to be involving the implant. A 2-mm punch biopsy knife was then used to remove all projectiles involving the skin. Her postoperative course after implant removal and replacement with...
new silicone implants was uneventful, and she made a full and complete recovery (Figure 2). She was last seen in April 2014, at 5-month follow-up.

**Case II: Firearm Injury (Handgun, Hollow Point Bullet)**

The authors report and update a previously published case where a 34-year-old woman with subpectoral saline breast implants (350 cc smooth round moderate plus implants overfilled to 390 cc) presented to the University of Utah emergency room in October 2016 after a close range (between 12 and 24 inches) firearm injury to the right chest. The firearm was a Springfield XDM, chambered in .40 S&W with a 4.5-inch barrel length. The ammunition loaded was Winchester Ranger LE in .40 S&W, which contains a 180 grain jacketed hollow point bullet, expected to travel at 990 feet/s. A CT scan of the chest showed no penetrating intrathoracic injury, and physical examination showed an entry wound at the nipple, an exit wound in the axilla, and a portion of the saline implant protruding from the axillary wound (Figure 3A).

In the operating room, we identified a pyramid-shaped injury with the nipple wound at its apex. At the base of pyramid, there was an injury to the periprosthetic capsule directly over a rib (Figure 3B). The exit wound occurred at the midaxillary line and the three points of injury could not be connected using a straight line, indicating that the bullet trajectory may have been altered by the implant or...
that the bullet may have deflected off of a rib and exited via the axillary wound. The patient healed uneventfully from her initial debridement and closure, and returned to the operating room 6 months later. For breast symmetry, she had subpectoral placement of a 375-cc moderate plus profile saline implant, overfilled to 425 cc on the injured side. Pre- and postoperative images are shown in Figure 3C and D. She was last seen in August 2017, 10 months after initial injury.

This patient case prompted us to perform a ballistics study to examine the impact of saline breast implants on bullet deformation and ballistics gel penetration. Briefly, using the experimental design shown in Figure 4A, we demonstrated that the presence of a saline implant had a protective effect against bullet penetration, and specifically caused earlier bullet deformation with increased drag force and resultant velocity reduction. As a result, the saline implant’s presence resulted in a 20% decreased penetration into ballistics gel (31.9 cm vs 40.2 cm, \( P < 0.001 \)). We hypothesized that the slowed bullet might be more likely to deflect off of or be stopped by a rib with decreased risk for intrathoracic injury. A representative gel pair (saline implant above and no implant control below) is shown in Figure 4B. The presence of a saline implant in this patient would have caused earlier bullet deformation with resultant velocity reduction. This may have allowed the bullet to ricochet off of, as opposed to penetrate, the rib. The altered drag forces from the expanded projectile may also have altered the bullet’s course.

**Case III: Goring (Bull Horn)**

A 54-year-old woman with a history of silicone breast implants presented to emergency department of the Mayo...
Clinic—Scottsdale in July 2016 with a tender, erythematous, and swollen right breast. Fourteen days prior, she had sustained an injury to her right chest and foot during the Running With The Bulls event in Pamplona, Spain. She was gored in the chest with a bull horn, and also had multiple metatarsal fractures. In an emergency department in Spain immediately after the incident, her chest wound was closed with a single-layer running suture, and she was

**Figure 4.** Previous experimental design (A) showing a significant decrease in bullet penetration with (lower) and without (upper) a breast implant (B).

**Figure 5.** (A) A 54-year-old female (Patient 3) after goring injury with infected right breast implant. Intraoperative photos showing the extent of defect through muscle to skin (B) with demonstration of trajectory of horn through skin, muscle, and into implant (C, D).
prescribed a 7-day course of amoxicillin-clavulanic acid. On post-trauma day 14, she presented to the emergency department with an erythematous, swollen, and painful right breast (Figure 5A).

The patient was taken to the operating room immediately, where bilateral breast implant removal and rightsided complete capsulectomy were performed. The patient had a 5 × 5-cm defect in her superior-medial pectoralis muscle, which allowed the silicone from the ruptured implant to migrate from its initial subpectoral location to a site just under the subcutaneous layer (Figure 5B–D). The implant was surrounded by a thick biofilm that was incorporated into the capsule. Cultures grew methicillin-resistant coagulase-negative staphylococci, and the patient was treated with a 14-day course of oral trimethoprim–sulfamethoxazole 500 mg twice daily.

Goring injuries typically have a small entrance wound, but because of the rotational forces from the bull’s head, they have extensive underlying damage that can be in a full 360° range from the entrance wound.9-13 For this patient, the presence of a submuscular silicone implant may have been protective in two distinct manners—these include: (1) increased vertical distance between the skin injury and chest wall, making intrathoracic penetration less likely; and (2) direct force absorption and cushioning of the horn tip to decrease posterior capsule and chest wall trauma.

After the patient completed the antibiotic treatment and was free of infection for 6 weeks, she elected replacement of her implants. They were replaced with 400-cc ultra–high-profile round silicone implants with 40 cc of fat grafting to right breast.

defect, and the muscular layer was thin and incorporated into the scar tissue. Healing was uneventful, with no recurrence of infection or other complications. Pre- and postoperative photos, taken at 1 month after surgery, are shown in Figure 6.

**DISCUSSION**

This article describes three women with breast implants who had different types of penetrating traumatic injuries. In Case 1, the breast implant clearly provided a protective effect as it prevented shotgun pellets from injuring the chest wall. For Case 2, a ballistics study8 (Figure 4) clearly demonstrates that the presence of a saline implant creates earlier bullet deformation, increased drag force, and direct velocity reduction. Thus, in Case 2, the velocity reduction could plausibly have allowed the bullet to deflect off, instead of penetrate, the underlying rib, thus sparing an intrathoracic injury. In Case 3, a submuscular silicone implant increased the required penetration distance for an intrathoracic injury to occur in a goring injury, and would have directly absorbed force as well. In all presented cases, the presence of a breast implant was potentially life-saving.

There are three additional case reports in the literature14-16 that describe gunshot injuries in patients with breast implants. For the two cases14,15 in which the trajectory is clearly delineated, these appear to have been tangential injuries that may not have contacted the chest wall. For gunshot injuries that are relatively low energy (such as the shotgun injury in Case 1),7 the implant has the potential to be protective via direct velocity reduction and force absorption—allowing the low-energy projectile to be stopped within the implant itself. For higher energy gunshot injuries, the implant would similarly provide...
direct velocity reduction and force absorption, but may also impact the timing of bullet deformation—the resultant increased drag force could provide additional projectile slowing. The three presented cases and one ballistics study provide objective data that breast implants can have a protective effect in penetrating trauma—the magnitude of this protective effect would certainly depend on individual patient circumstances, as well as the nature of the penetrating injury itself.

For non-firearms penetrating trauma, such as a stabbing injury, the potential protective effect of an implant is obvious: the implant increases the vertical distance between skin and chest wall, and can decrease the risk for intrathoracic penetration. We were unable to identify a published case report or case series of stabbing injuries and breast implants on PubMed. However, several cases have been discussed in the popular media.\(^1\)\(^7\)\(^1\)\(^7\)\(^8\)

The authors acknowledge that penetrating chest injuries in women with breast implants are uncommon. Current estimates show that around 4% (5 million women in total) of women in the United States have breast implants. Approximately 12,000 women in the United States have fatal or nonfatal firearm–associated injuries per year,\(^1\)\(^9\) meaning that these data are directly relevant to only 480 women in the United States each year. The authors acknowledge that these circumstances are uncommon, but also note that they prompt plastic surgeons to consider a much more common scenario, specifically blunt trauma from falls.

Falls are a major source of morbidity in the United States, and specifically are the number one cause of nonfatal and fatal injuries among the population over 65 years old.\(^2\)\(^0\) In 2012 alone, 24,000 fatal falls and 3.2 million nonfatal falls occurred in the United States for people aged over 65, with direct medical costs of over 30 billion dollars.\(^2\)\(^1\) Women are twice as likely to experience falls than men.\(^2\)\(^2\)\(^2\)\(^3\) One in four persons aged over 65 will fall each year, and one fall in five results in fracture or head injury\(^2\)\(^4\) and many patients sustain blunt chest trauma. Current estimates indicate that over 5,000,000 women in the United States have breast implants.\(^1\) Thus, each year literally tens of thousands of women with implants will experience falls from standing, and the majority of these women will sustain blunt chest trauma. As this population ages, and patients with implants become more likely to fall, that number could increase to hundreds of thousands of women with implants who experience falls from standing each year.

The protective effect of breast implants against chest wall trauma in falls from standing has not been studied. Force from a fall is transmitted from the external environment through the skin and breast tissue, through the implant, and to the chest wall. Thus, the distribution and intensity of that force will be altered by the breast implant, through both a cushioning and deceleration effect and a direct impact shielding. The presence of an implant could plausibly impact the extent of deep tissue injury, rib contusions, or rib fractures through force distribution or dispersion. Studies examining this question would be directly relevant to the thousands of women with implants who fall each year, and would become increasingly relevant over time as the cosmetic breast augmentation population and reconstructive population ages. The presence of an implant affects the force transmitted to the chest wall in an unknown manner, and this potential safety implication of implants cannot be intelligently discussed with patients in the absence of data. Public interest in this novel line of research is high—a summary of our prior work examining the protective effect of implants in firearms injury received 2.6 million views on one social media page.\(^2\)\(^5\) Each of these facts makes this topic an intriguing and important direction for ongoing research efforts.

**CONCLUSION**

We have described three separate real-world cases where the presence of breast implants was preventative against intrathoracic injury in penetrating trauma. We have shown that revision augmentation can produce aesthetically pleasing results in the setting of prior penetrating trauma. In addition, we have provided conceptual justification for how implants might minimize chest wall trauma in blunt or nonpenetrating injuries. Further research into the protective effect of breast implants in trauma patients is justified.

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