Mechanical characterization of breast prosthesis: static analysis

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Abstract

Silicone gel breast implants have been worldwide used for over 50 years, since their invention by Cronin in the early 1960's.[1] The number of women undergoing breast augmentation has grown throughout the years and it has been estimated that almost 3.5 million people in US have breast implants. Among the multiple complications associated with the use of breast implants we are focusing on the implant rupture. It is especially difficult to render comparable rupture rates among different types of breast implants and manufacturers.

Among the different mechanisms proposed for implant rupture, the most common is the damage from surgical instruments (51-64% of all causes), followed by unidentified opening/rent without indication of cause (no evidence of sharp instrument damage, 35-37%), fold flaw (8%), shell swelling (reduction of the shell strength due to migration of the silicone fluid from the gel to the shell), delamination, manufacturing defect, surgical impact and trauma to the implant, like an external pressure to the chest or closed capsulotomy. Focusing on the traumatic rupture, we know that most trauma do not cause a prosthetic rupture, except in case of blunt trauma. After an accurate review of the scientific literature we discovered that there are no studies regarding the relationship between the impact loads, which typically can occur in a car accident, and the risk of breast implants rupture. As a matter of fact, in the event of an accident, loads from the seat belt are normally transferred to the breast. For this reason, our group decided to study the mechanism and the physical aspect of the impact and how this is related to the possible damages of the breast implants. In the first phase of the research, different compressive tests in static condition were carried out to determine rupture loads and deformations. A maximum pressure limit was identified after which the implant developed a permanent deformation and was more inclined to rupture. Data from these tests were used to identify a critical condition for the impact tests.

These tests will be carried out at the laboratory of the Aerospace Engineering Department of the Politecnico di Milano. The test facility consists of a sled that can be accelerated to a desired speed and stopped with a particular deceleration history. A complete seat with belts will be mounted on the sled and an anthropomorphic dummy with the breast prosthesis implanted will be used.