

# Measuring the Breast: From Surgery to Bra

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## Abstract

The fit of a bra is crucial to a woman's well-being, in that poorly fitted bras cause discomfort, muscle tension, fatigue, and pain. In a preliminary focus group study, we found that 53% of women with breast reconstruction were less satisfied with their bra fit after surgery and 46% were less satisfied with their bra comfort. Due to breast size, shape, and symmetry changes after mastectomy and reconstruction, women in this patient population may have more difficulty in finding a properly fitting bra. In this study, we identified how clothing industry measurements relate to standard surgical measurements and how the two areas can be connected. We also studied the differences in pre-operative and post-operative breast shapes of women who have undergone mastectomy and breast reconstruction to assess the effects of surgery on bra fit by performing measurements on 3D torso images of patients. We will continue to conduct analysis to search for asymmetry trends that might inform the clothing industry as to how bras need to be adjusted for women with breast surgery.

## Background

### Breast Reconstruction:

- A common treatment of breast cancer is mastectomy—the removal of one or both of the breasts.
- After mastectomy women can choose whether to undergo breast reconstruction to reform their breasts
  - Three types : autologous-based (using the patients own tissue), implant-based, and combination of implant/autologous
- Breast reconstruction changes the size, shape, and symmetry breasts (Figure 1)

### Bra Fit:

- Poor bra fit can cause discomfort, muscle tension, fatigue, pain, and psychological effects that stem from dissatisfaction with body image.
- Bra fit has been studied with healthy women but not with women who have had breast surgery

## Materials and Methods

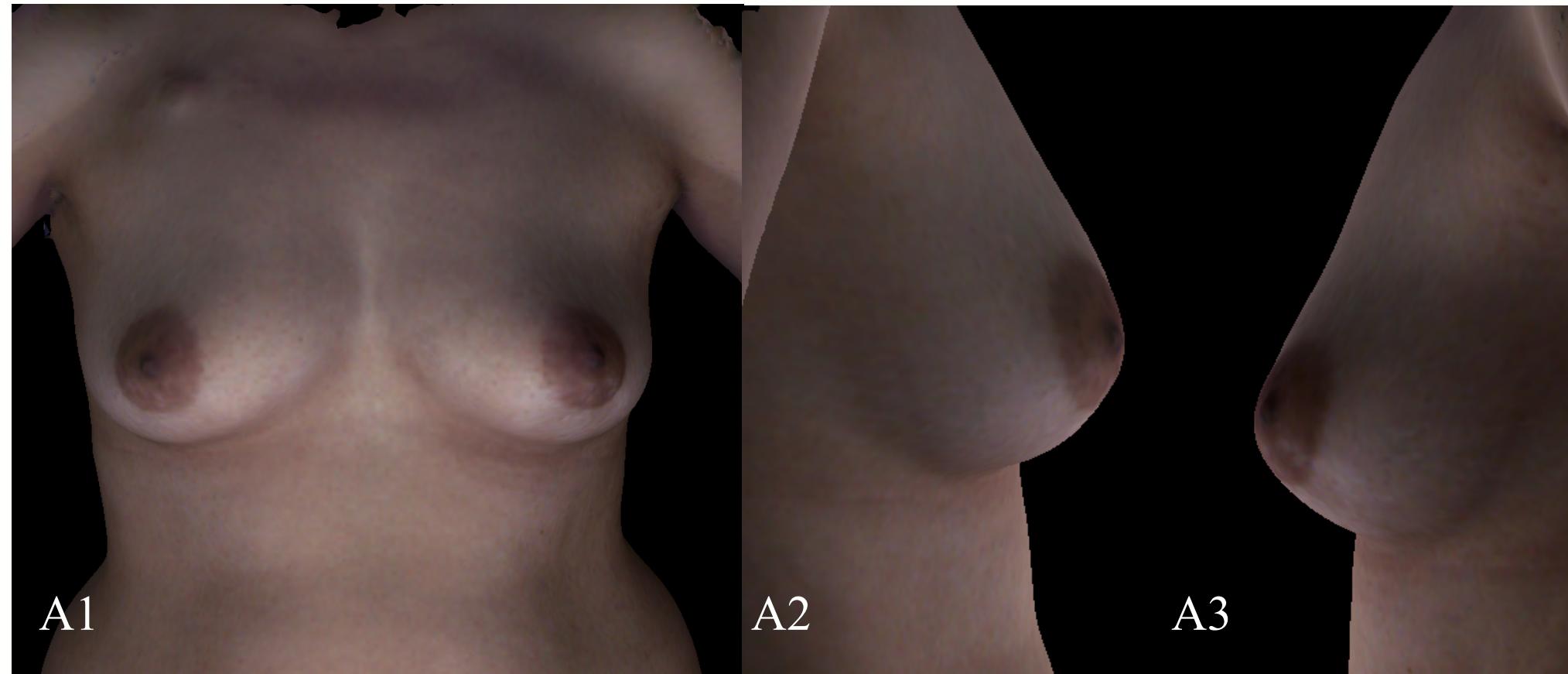
### Relating Bras to Surgery:

- A clothing expert and reconstruction surgeon collaborated to decide what measurements of the breast are used in both applications. We decided to focus on 7 measurements based off of 8 standard torso fiducial points (Table 1).

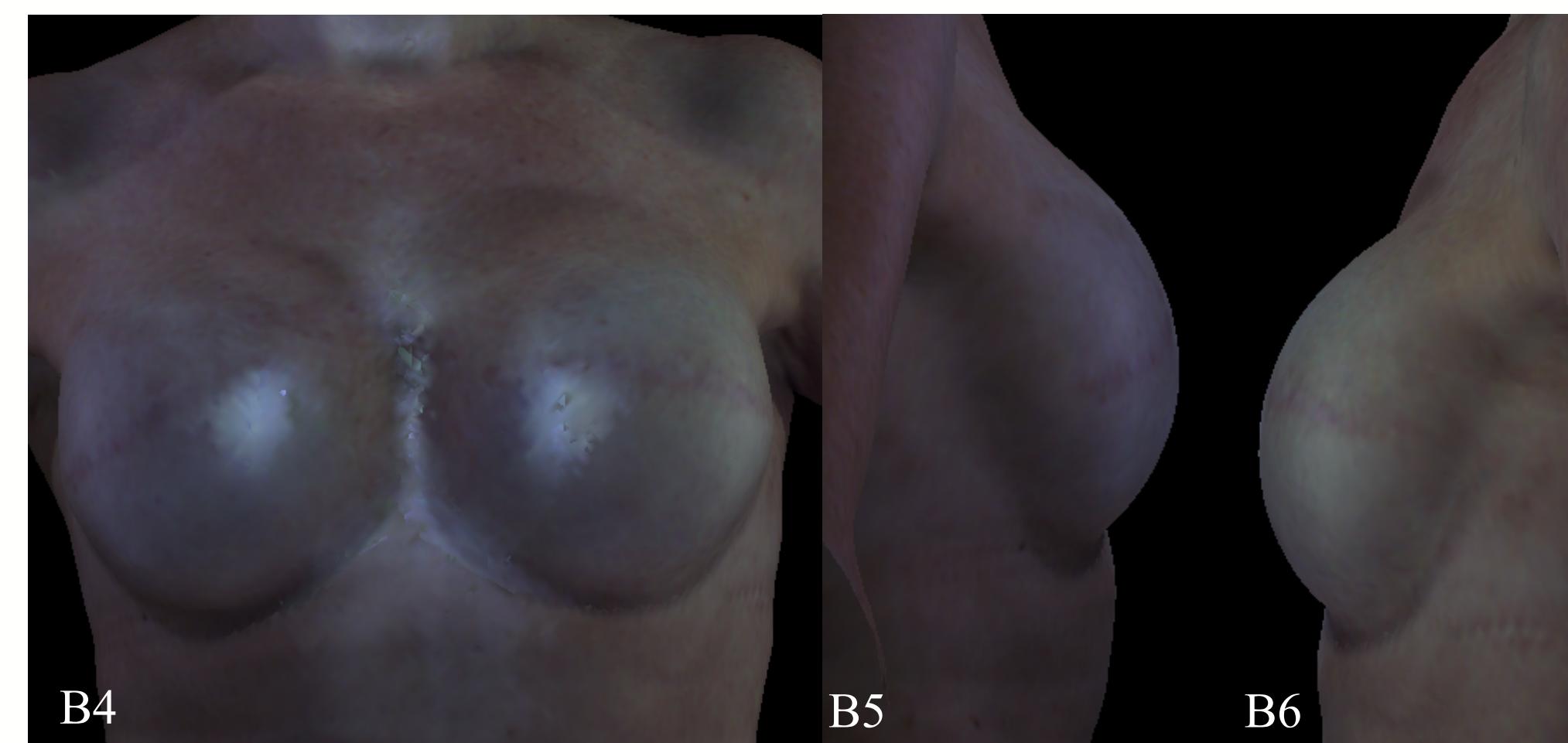
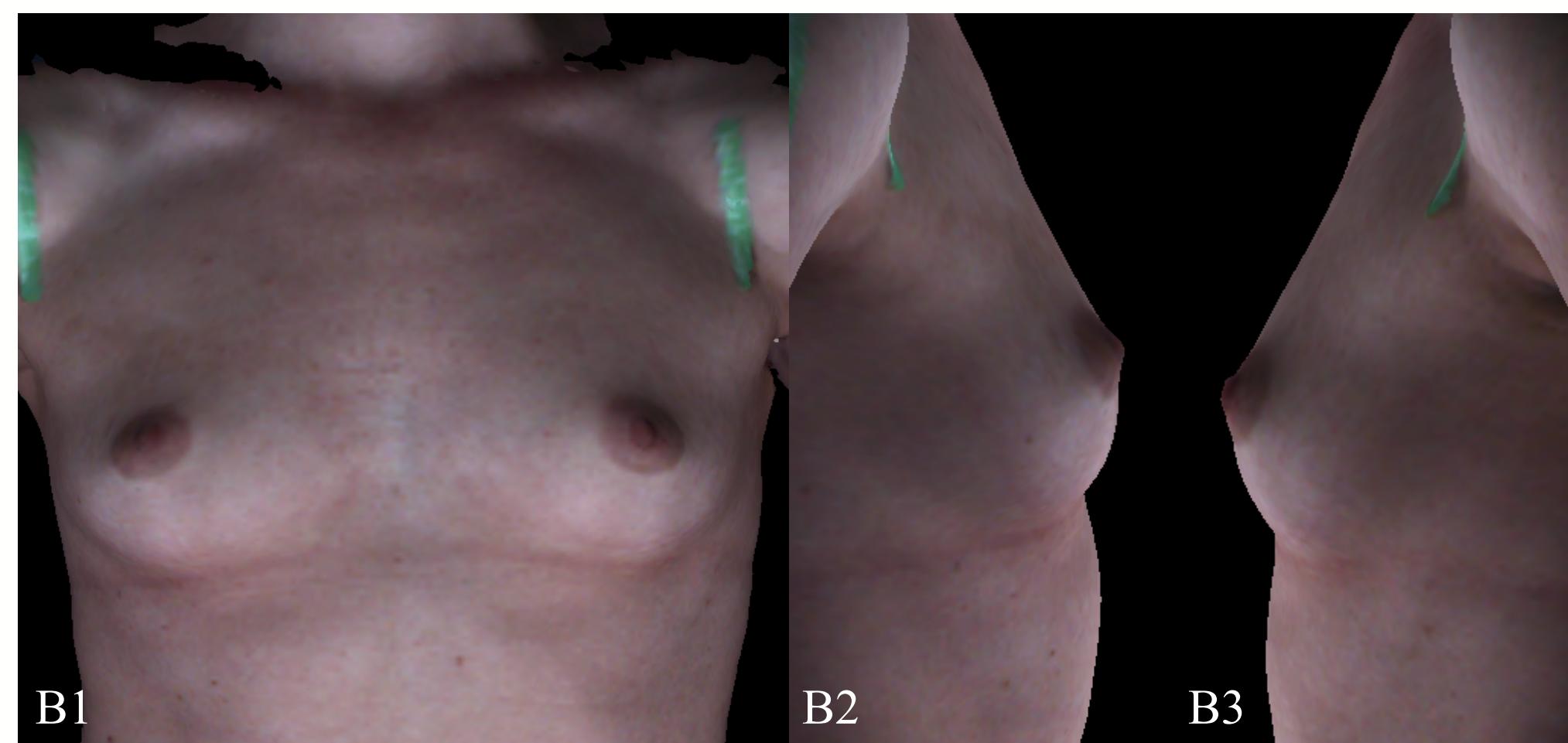
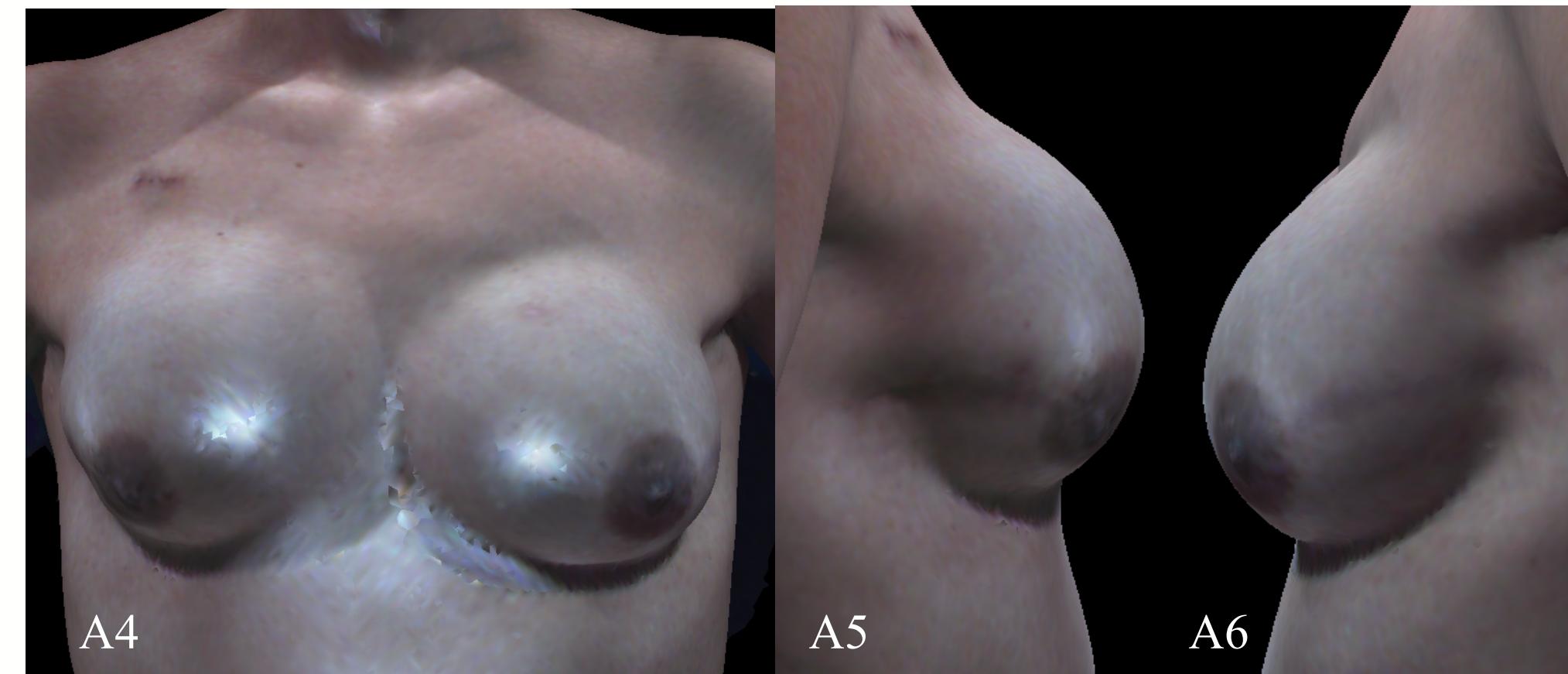
### Measurement Efficacy:

- Patient selection: From a database of 3D torso images of 505 women who had breast reconstruction at The University of Texas MD Anderson Cancer Center, we selected patients who had two natural breasts at the pre-operative image and final implant based reconstruction at the post-operative time point.
- The time between initial surgery and final insertion of breast implants varied amongst the patient population from 6 months to 18+ months. Measurements were gathered from images taken at least 3 months after final implantation.
- Training under Dr. Greg Reece, a plastic surgeon from MD Anderson Cancer Center, was necessary for correct fiducial point placement.
- An in-house, custom-made software from our University of Houston collaborators was used to select the 8 fiducial points on 72 pre- and post-op images.

**Breast Shape Before Reconstruction**



**Breast Shape After Reconstruction**



**Figure 1**

Row A:

Change in breast shape after implant breast reconstruction.  
Images A1-A3 show the pre-operative breasts of the patient.

Images A4-A6 show the post-operative breasts of the patient. There is change in the breast shape and more fullness at the top of the breast.

Row B:

Change in breast size after implant breast reconstruction.

Images B1-B3 show the pre-operative breasts of the patient.

Images B4-B6 show the post-operative breasts of the patient. From the lateral views, there is change in the breast size and the breasts are more outwardly projected than in the pre-operative images.

Row C:

Change in breast symmetry.

Images C1-C3 show the pre-operative breasts of the patient. There is change in the symmetry of the breasts, more fullness at the top of the breasts and asymmetric ptosis in the breasts.

Because breast shape undergoes drastic changes after implant-based breast reconstruction, the average bra will not accommodate the needs of women who have undergone breast reconstruction. The differences in breast shape, size, and symmetry found in this study can be communicated to clothing designers for providing more options to women who have undergone breast reconstruction by designing bras that fit their needs.

**Table 1: Clothing design measurements**

Clothing Terminology	Definition
Bust Point Distance	Distance between most projecting points of each breast
Under-Bust Point of Breast Base to Bust Point	Distance from inframammary fold to most projecting point for each breast
Front Neck Point to Bust Point	Distance from sternal notch to most projecting point for each breast
Front Point of Breast Base to Bust Point	Distance from medial point to most projecting point for each breast
Side Point of Breast Base to Bust Point	Distance from lateral point to most projecting point for each breast
Center Front Point on the Bust Line to Bust Point	Distance from midline to most projecting point for each breast
Mid-shoulder Point to Bust Point	Calculated as twice the distance of the midpoint between the mid-shoulder point to bust point

## Completed Work

- All 7 fiducial point measurements were taken for 36 patients at pre-operative and post-operative time point.
- Each fiducial point measurement was reviewed by Dr. Greg Reece, a plastic surgeon at MD Anderson Cancer Center.
- Although all patients have had implant-based reconstruction, the time at which the breasts were evaluated after the breast reconstruction surgeries varied amongst the patients.

## Next Steps

- The eight measurements will be compared between pre-operative and post-operative breasts to determine the differences in the sizes, the shapes, and the symmetry between the right and left breasts.

## Conclusions

- Because patients who undergo breast reconstruction for prevention or treatment purposes have altered breast shapes, size, and symmetry, it is imperative to acknowledge these shape changes so that bras can be made to fit the needs of breast cancer patients.
- The results will allow healthcare providers to predict bra fit of the patient depending on her body type and have a better recovery trajectory with better bra fit.
- These results will provide clothing designers with measurements for creating bras to fit the needs of patients who have undergone breast reconstruction.
- Using these methods, future studies on different types of breast reconstruction may help determine which type of breast reconstruction produces the most changes in breast shapes related to bra fit.

