

Measuring Changes in Breast Shape of Breast Reconstruction Patients for Improving Bra Design

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Abstract

A change in bra fit is a common quality of life issue faced by breast reconstruction patients because mainstream bra designs are based on the shape and contours of native breasts. In order to identify common changes in breast size and shape due to reconstructive surgery, we made 8 measurements on 3D images of breast reconstruction patients at a pre-operative time point and a post-operative time point. We compared the measurements between the pre-operative and post-operative time points as a preliminary method to quantify the changes in breast shape that occur due to reconstruction.

Background

- Breast cancer patients face many quality of life issues following breast reconstruction surgery, including changes in clothing and bra fit.
- Mainstream bra designs are based on measurements of native breasts, the shape and contours of which differ from reconstructed breasts.
- We have previously translated the measurements used in bra design to clinical measurements used by plastic surgeons in order to use clinical photographs to inform bra design [1].
- This project aims to identify common changes in breast size and shape due to reconstructive surgery, and translate this into data useful for bra design, so that the needs of post-operative reconstructive patients can be better taken into account.

Materials and Methods

PATIENTS

- 54 breast reconstruction patients (from a database of 505 patients) from The University of Texas MD Anderson Cancer Center, who had:
 - Two pre-operative native breasts
 - Final implant-based reconstruction

DATA

- 3D surface torso photographs of the 54 patients at the pre-operative time point and a post-operative time point [2].

DATA COLLECTED

- The following fiducial points were marked of each patient using our institutional 3D modeling software: nipple (N), most projecting point (MPP), inframammary fold (IMF), lateral point (L), sternal notch (SN), mid-clavicle (MC), transition point (TP), midline (M), medial point (MP). See Figure 1 for location of these points.

Materials and Methods

- MPP – most projecting point
- IMF – inframammary fold
- L – lateral point
- SN – sternal notch
- MC – mid-clavicle
- TP – transition point
- M – midline
- MP – medial point

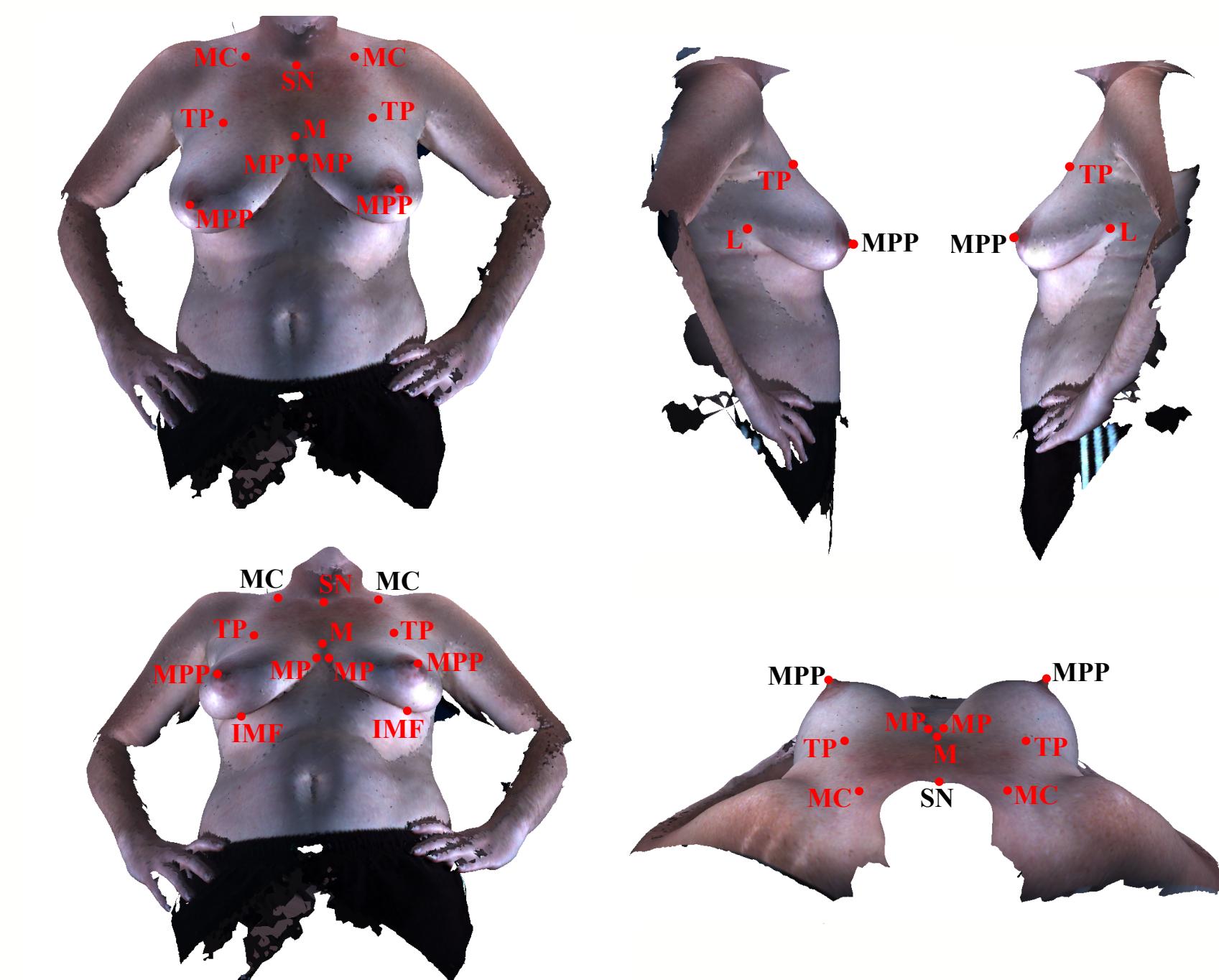


Figure 1. Definitions of fiducial points as displayed on images of a patient's breasts at the pre-operative time point with two native breasts. Contoured and straight line measurements are then taken between these points for both the pre and post time points so the changes can be determined.

Challenges

Certain measurements between fiducial points could not be taken or required further consideration:

- In Figure 2a, the patient image was incomplete, and any measurements involving the SN and MC points could not be taken.
- In Figure 2b, the bandage on the patient's right breast would have altered the measurement between the right N and L points.

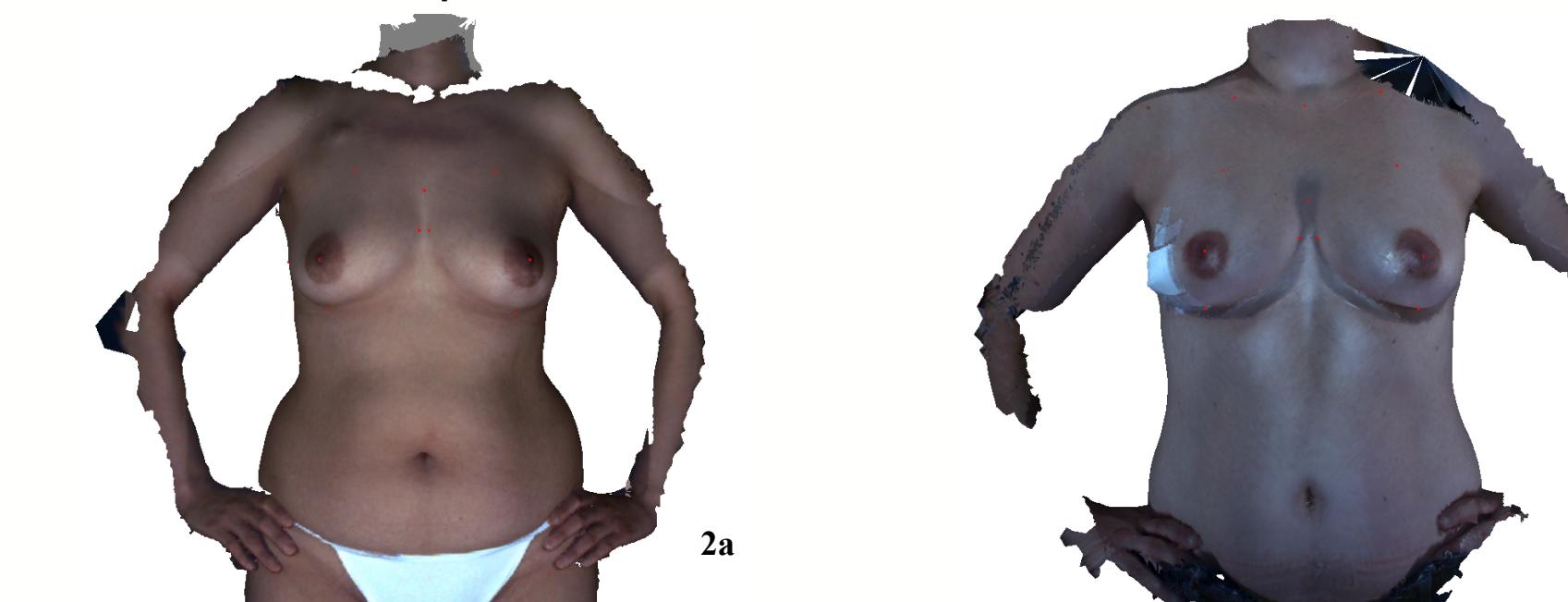


Figure 2. A) A patient image that is incomplete, and does not contain the SN or MC points, B) A patient image with a bandage on the right breast that will alter the right L to MPP measurement

- Tables 1 and 2 show the changes in measurements from the pre and post time points for the right and left breasts of 5 patients, respectively. Two kinds of measurements are represented: contoured and straight line.
- A contoured measurement is calculated by the modeling software by traveling between two points along the contours of the 3D model.
- A straight line measurement takes the shortest distance between two points, not traveling along the 3D model.

The images in Figure 3 show the pre and post time point images of patient D from the front, side, and top views.

- The red lines represent the contoured measurements.

Changes in Right Breast Measurements (mm)					
	Patient A	Patient B	Patient C	Patient D	Patient E
MPP to MPP (straight)	-30.03	-84.07	-31.96	-5.66	-9.24
SN to MPP (straight)	-49.82	-42.63	-7.77	-74.26	-20.06
IMF to MPP	3.16	-1.77	-8.07	-7.89	13.09
MP to MPP	-49.78	-49.21	-3.51	-45.63	-7.07
L to MPP	-4.28	1.97	12.85	-0.02	7.81
M to MPP	-44.09	-49.29	-3.3	-29.39	-9.98
MC to TP	-14.14	-20.35	-4.09	-61.32	-14.25
MC to MPP	-51.63	-31.58	-15.09	-88.58	-24.75

Table 1. Changes from pre-operative to post-operative measurements of right breasts for 5 patients. The measurements from MPP to MPP and SN to MPP were straight line measurements while the rest were contoured. Patient C underwent a unilateral reconstruction for the left breast so differences between the pre and post time point are not due to reconstruction. Patient E had a bandage on at the pre-operative time point that altered the L to MPP measurement.

Changes in Left Breast Measurements (mm)					
	Patient A	Patient B	Patient C	Patient D	Patient E
MPP to MPP (straight)	-30.03	-84.07	-31.96	-5.66	-9.24
SN to MPP (straight)	-29.77	-42.22	-31.49	-92.27	-24.2
IMF to MPP	2.09	5.88	-22.42	-4.85	6.32
MP to MPP	-6.21	-46.67	-32.46	-44.25	-7.27
L to MPP	3.08	14.27	-11.87	-26.01	3.37
M to MPP	-21.5	-45.65	-29.32	-32.54	-14.44
MC to TP	-7.73	-21.69	-10.73	-60.63	-25.62
MC to MPP	-29.79	-28.19	-13.71	-104.96	-38.53

Table 2. Difference between baseline and post-operative measurements (in mm) for 5 patients' left breasts. The measurements from MPP to MPP and SN to MPP were straight line measurements while the rest were contoured.

- For the 5 patients' data shown in the tables above, some consistencies between the changes in measurements emerge:

- The IMF to MPP measurement is usually the least altered.
- The MC to MPP measurement is usually the most altered.

Results

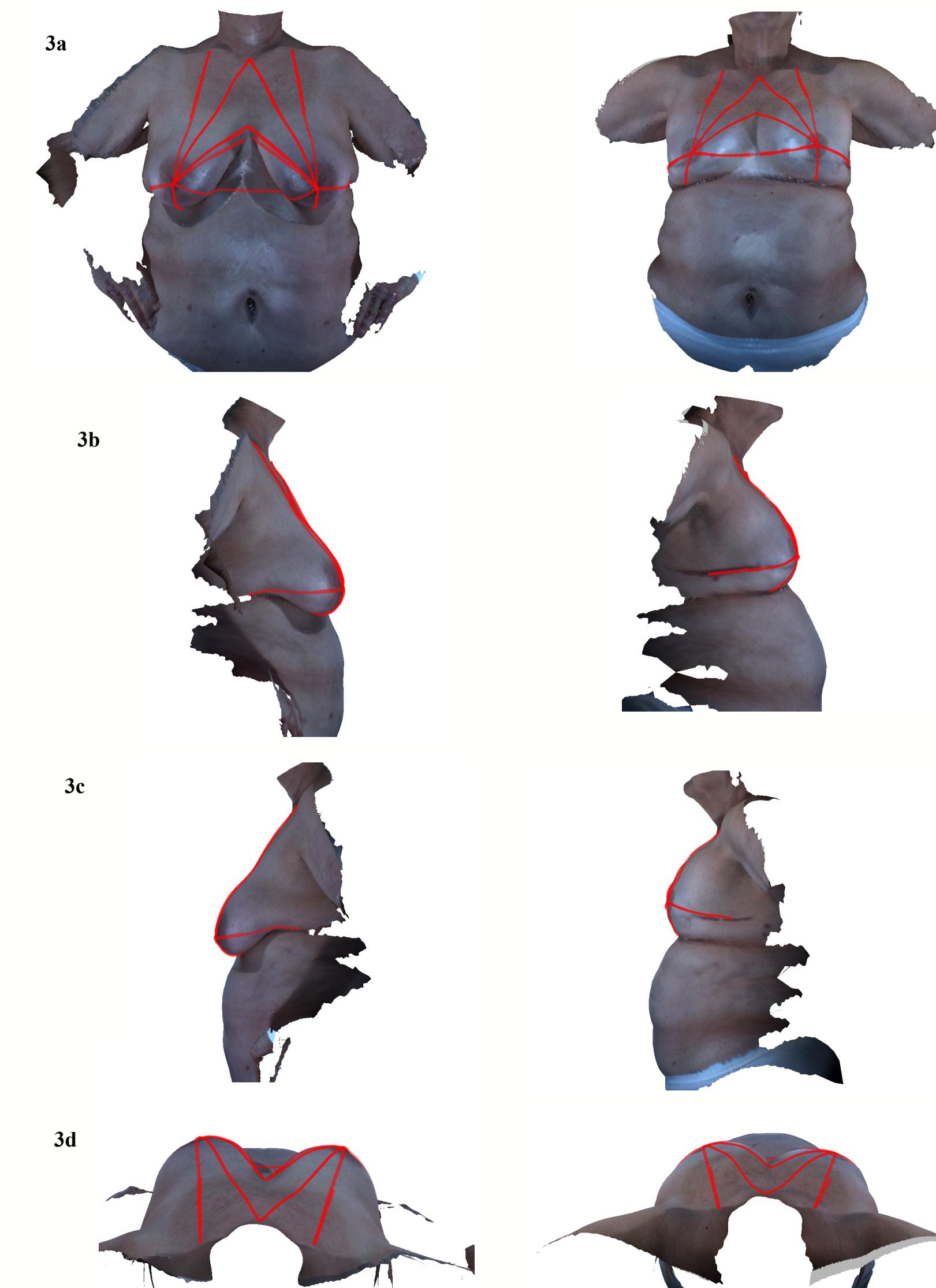


Figure 3. Measurements taken of patient D at the pre-operative and post-operative time points, with red lines representing the contoured measurements taken.

Discussion

- When a patient undergoes implant-based breast reconstruction, the end result is often somewhat spherical in shape. Because of this, the measurement from MC to MPP consistently decreases significantly, as can be seen in figure 3c.
- However, variations will always exist because of the natural variations between each patients' native breasts.
- In future work, the process of collecting these measurements can be used to gather more data which can be analyzed to identify any patterns present in how a patient's breast size and shape change following reconstructive surgery [3].

References

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