

Using Breast Density as an Indicator of the Side Effects and Change Induced by Tamoxifen and Radiation Treatment for Ductal Carcinoma in Situ

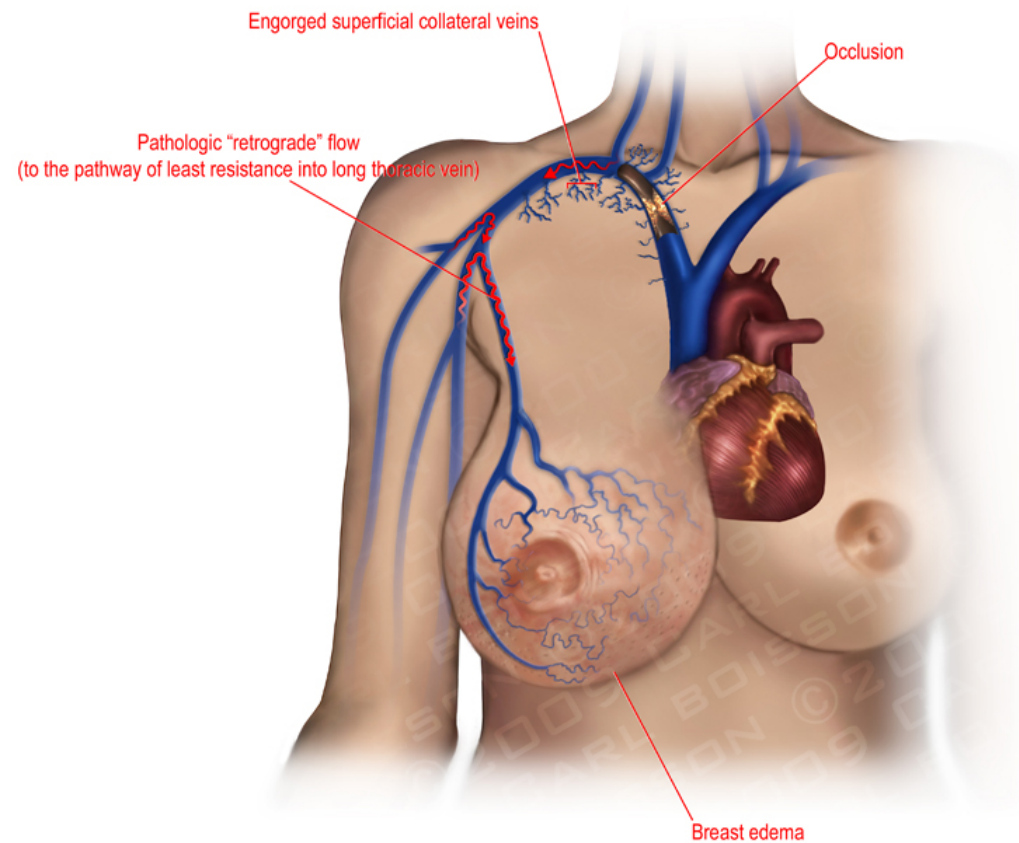
Sean Boyer

What is Ductal Carcinoma In Situ?

- DCIS is the *precursor* lesion for most invasive breast cancer
- ¼ of DCIS will lead to Breast Cancer

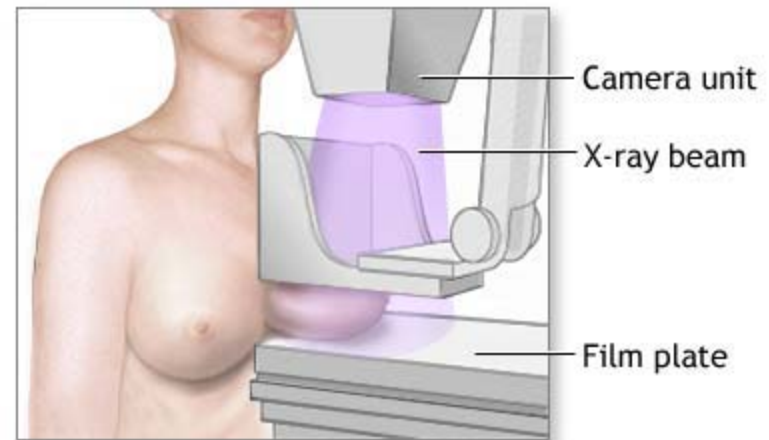
Radiation Side Effects

- Breast Appearance
- Skin
- Fatigue
- Fibrosis
- Edema



Breast Imaging

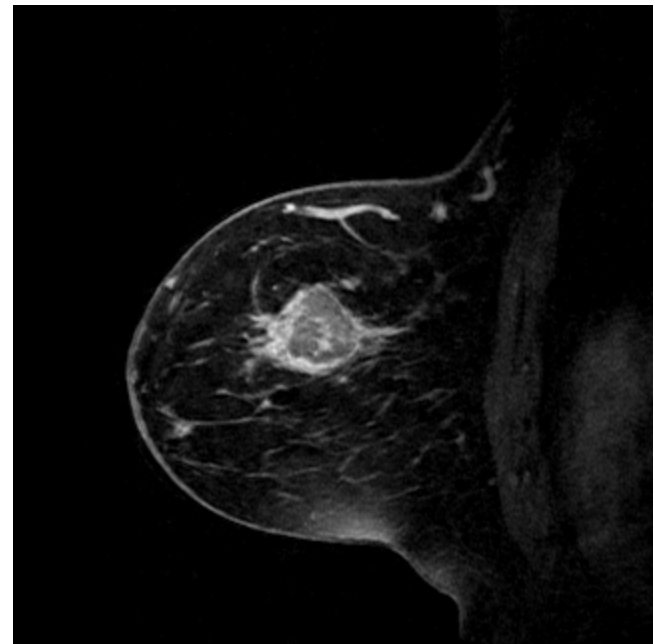
- MRI
- Mammography
- UST



In mammography, each breast is compressed horizontally, then obliquely and an x-ray is taken of each position

Breast MRI

- Pros:
 - Tissue Contrast
 - Resolution
 - Safety
 - Not affected by density
- Cons:
 - Cost
 - Time

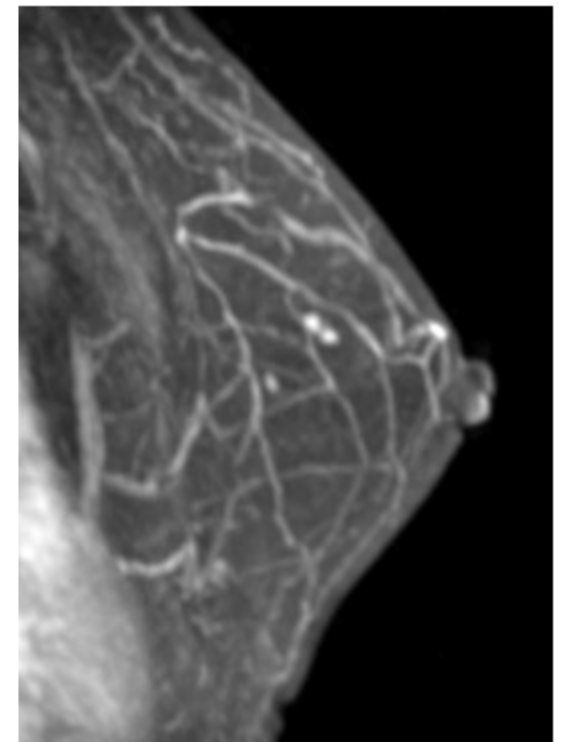


Mammography

- Pros:
 - Low Cost
 - Low Radiation
 - “Gold Standard”
- A Few Problems
 - Subjective
 - Ionizing Radiation
 - **Too many false positives**



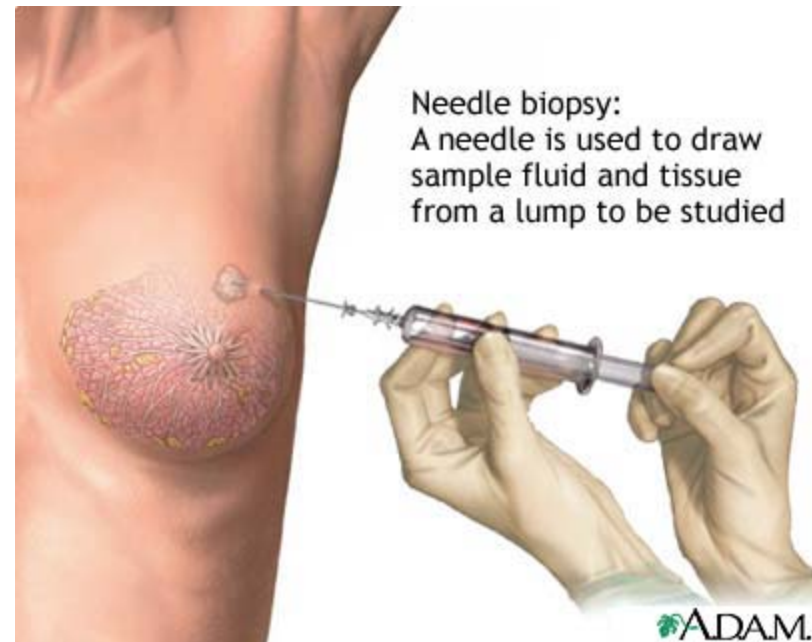
mammogram



MRI

Consequences of False Positives

- Unnecessary biopsies lead to
 - Wasted Time
 - Wasted Money
 - Unnecessary anxiety



Ultrasound Tomography

- Pros:
 - Short scan time
 - Great resolution / tissue contrast
 - Low cost
 - No ionizing radiation
- Cons:
 - ...?

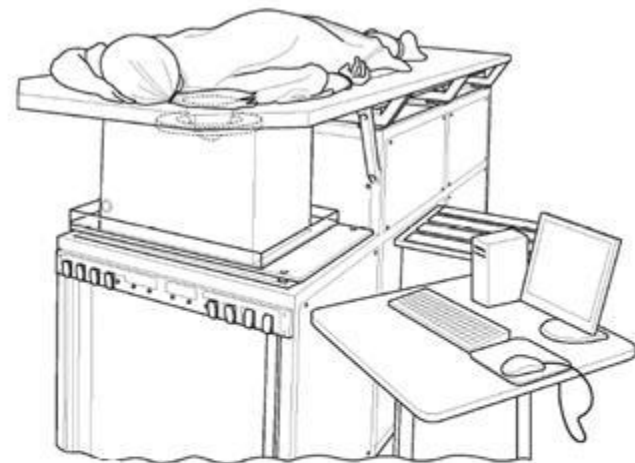
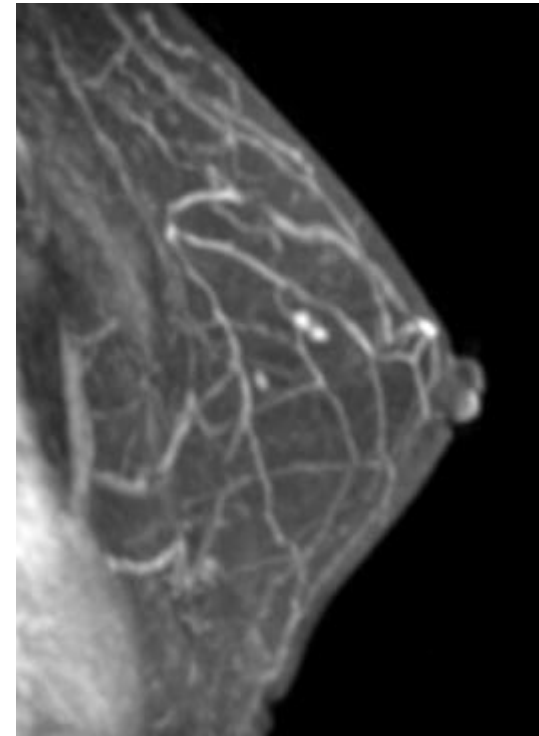
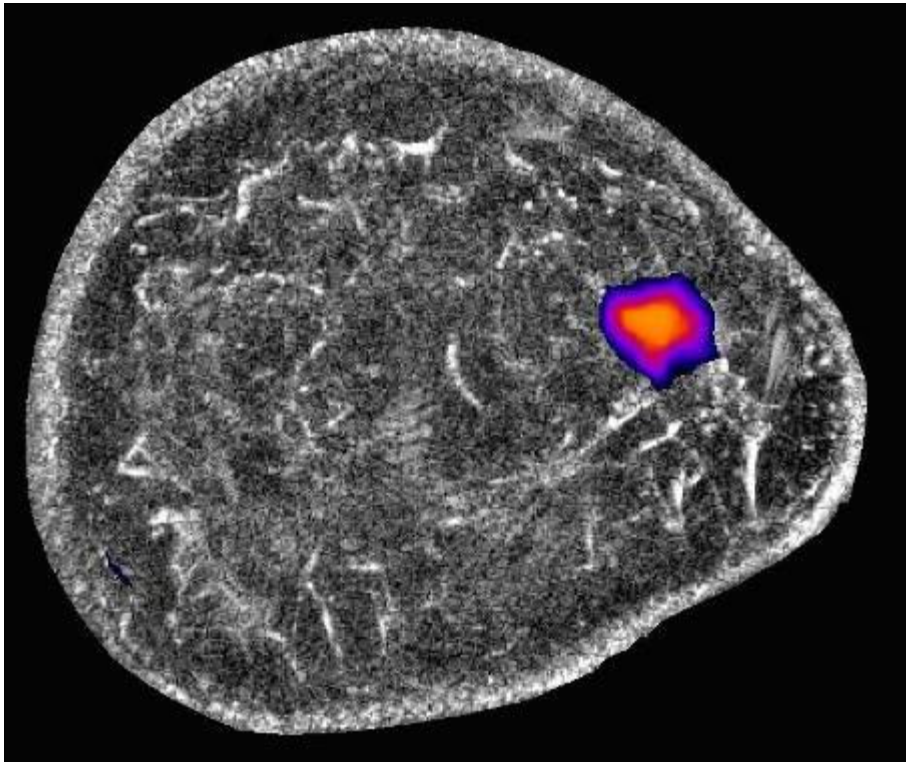


Figure 2: The UST clinical prototype. A patient lies in the prone position such that the breast is suspended inside a water tank that contains the ultrasound sensor. The water acts as a coupling medium to ensure that the acoustic waves can penetrate the breast efficiently.

UST vs. MRI Comparison



Breast Density

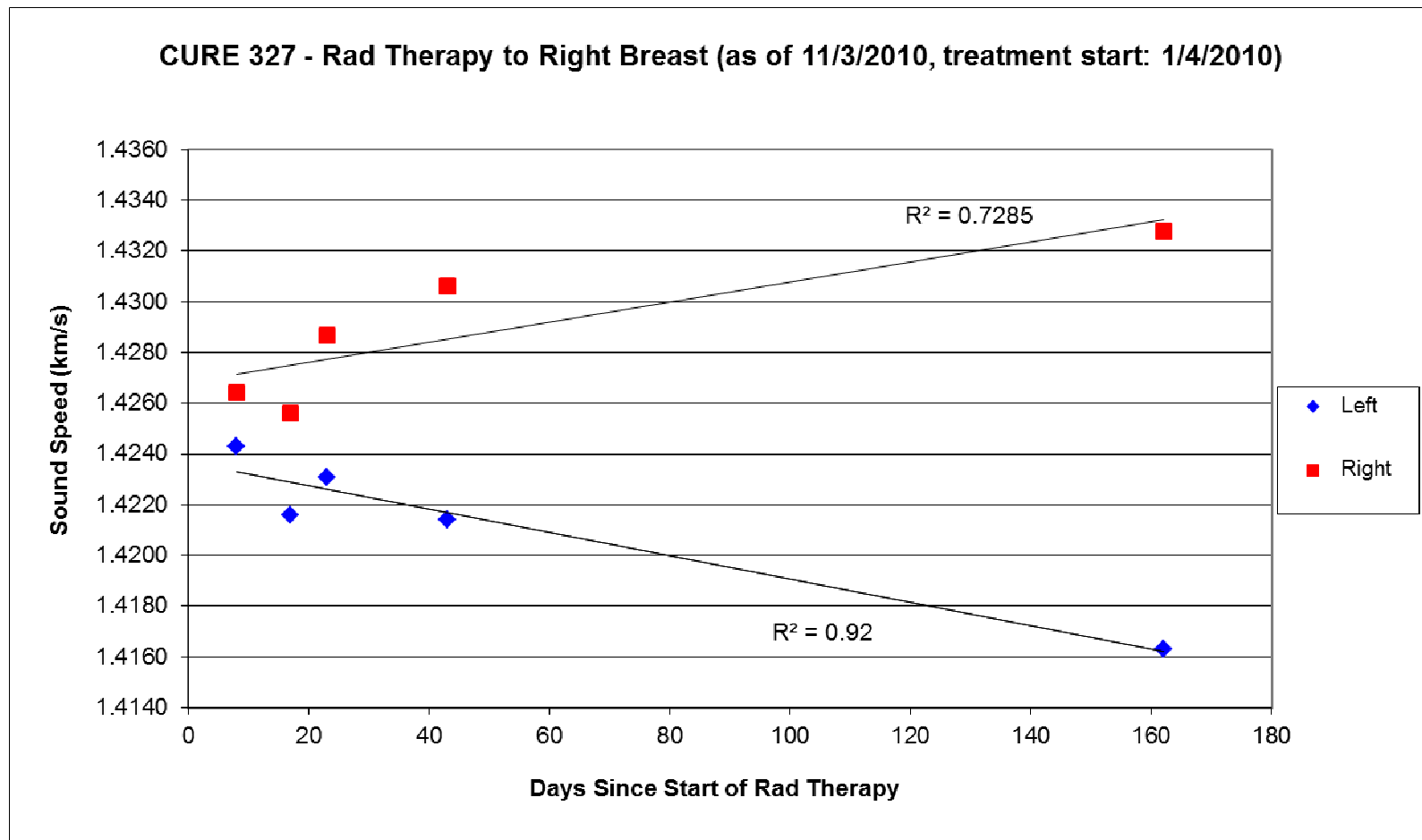
- Why does breast density matter?
 - Breast density is strongly associated with an increased risk in breast cancer
 - Mammography is more difficult with dense breasts

Does Breast Density Change During Treatment?

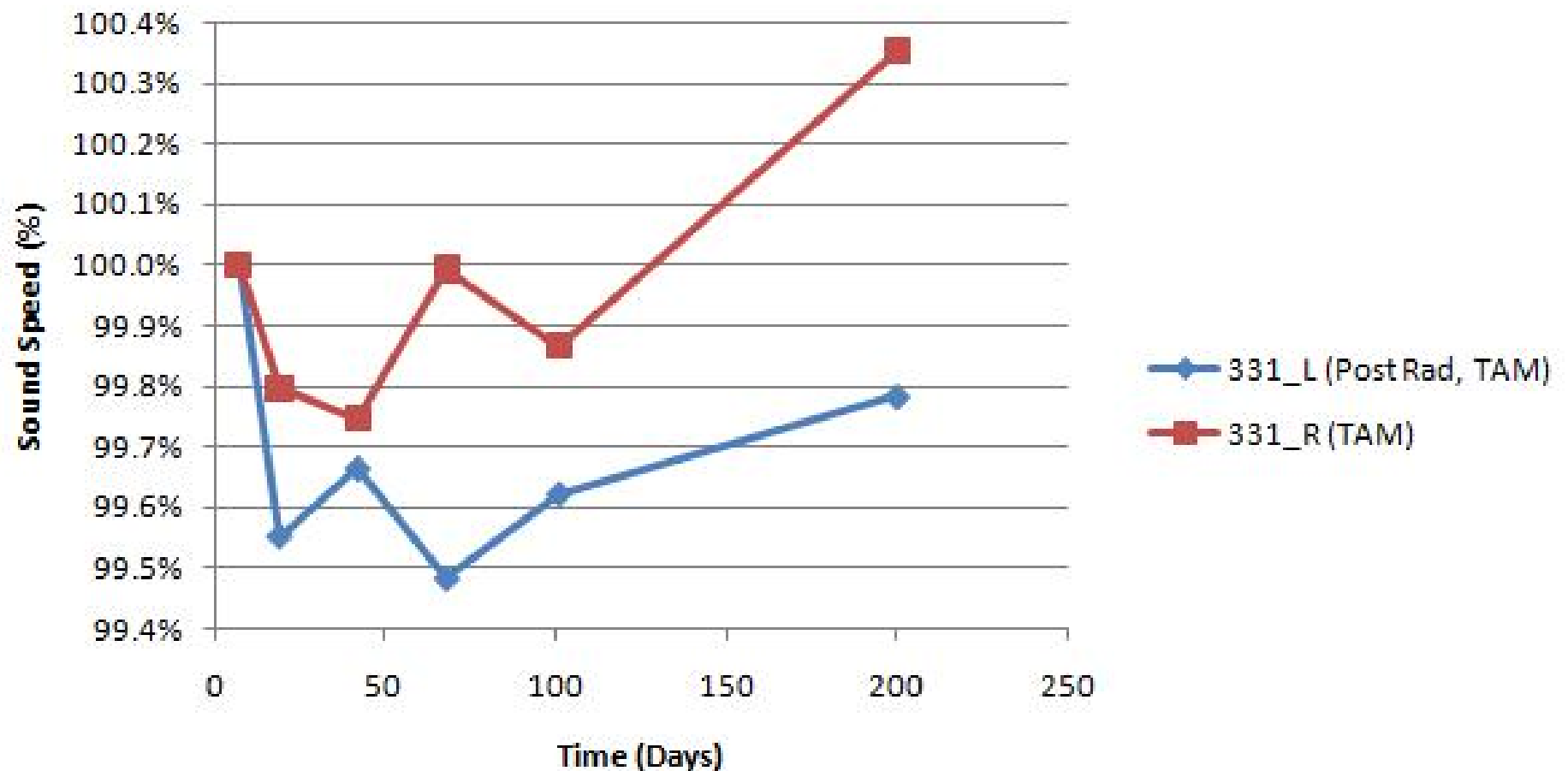
- Tamoxifen
- Radiation?
 - Recall: Edema, Fibrosis, etc...

Results

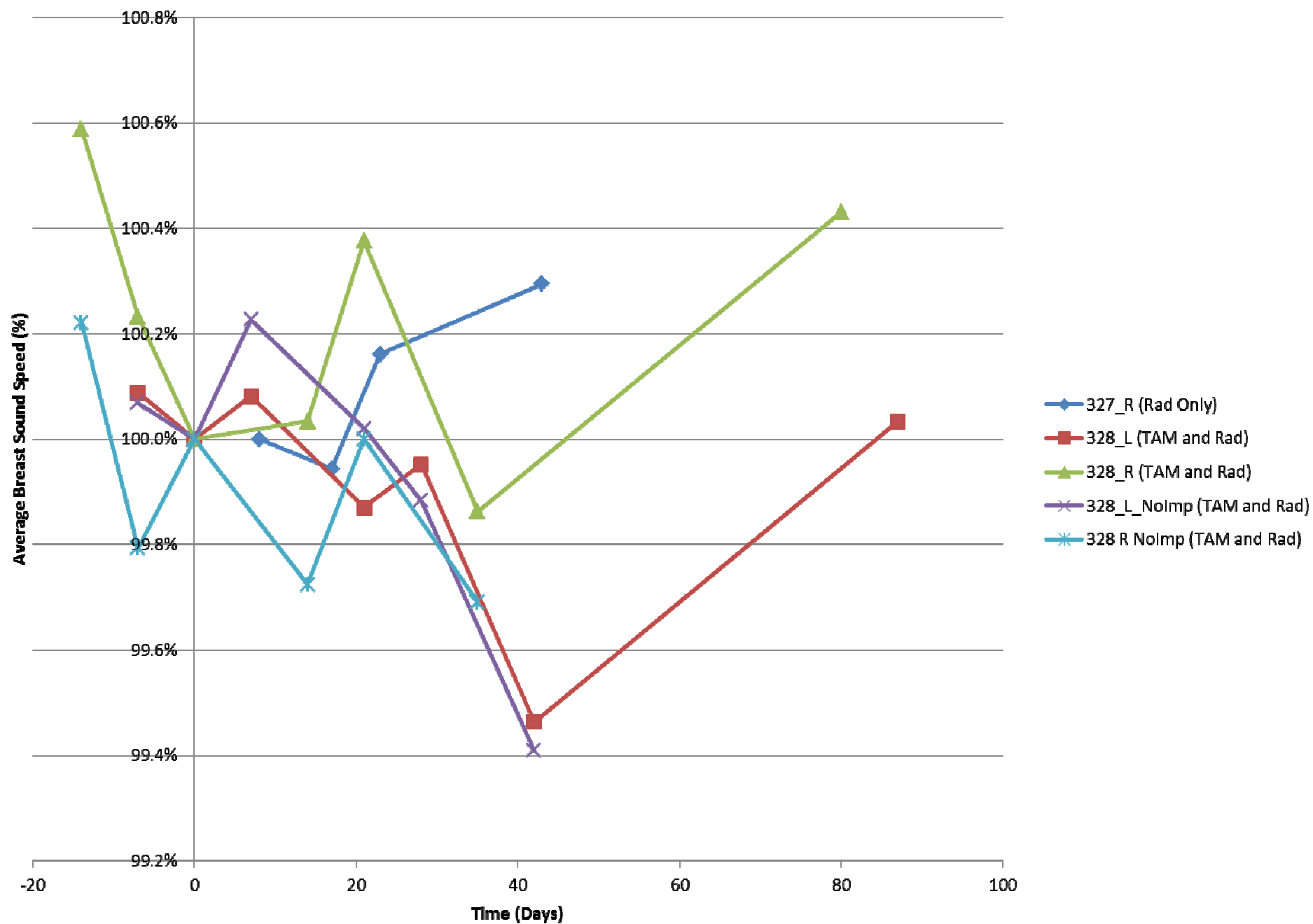
- One Patient's Experience:



Sound Speed Percentage vs Time by Patient on Tamoxifen



Irradiated Breast Sound Speed Percentage vs Time by Patient



Conclusion

- Need more data!
- We *can* detect changes in breast density in the time it takes to treat the patient
- Results look promising



Sound Speed -> Breast Density

- $c = \sqrt{C/\rho}$
- $C \propto \rho^3$
- Combining equations...
 - $c \propto \rho$