

Determination of the Physical Effects of Voids with MammoSite

Namratta Sehgal

With Dr. Bruce Thomadsen

And Dan McDonald

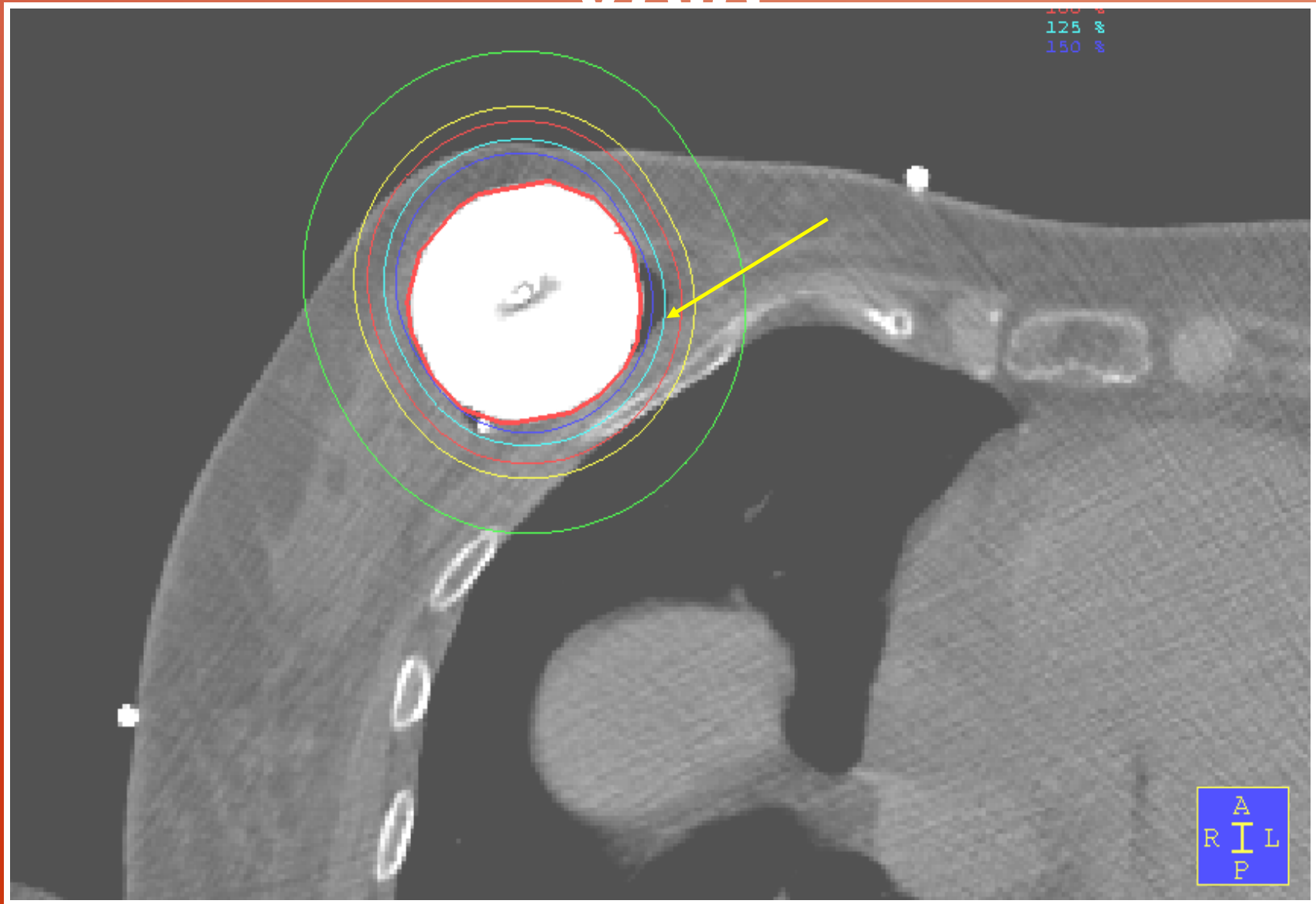
Department of Medical Physics

UW-Madison

Introduction

- Air pockets are sometimes trapped on the surface of the MammoSite balloon during insertion, pushing tissue outside the irradiation margin.
- Depending on the size of the air pocket, tissue could possibly be pushed out of the 1cm. margin receiving 100% of the dose.
- Practitioners wonder if they should alter or discontinue treatment because of the voids.

MammoSite Treatment with Void



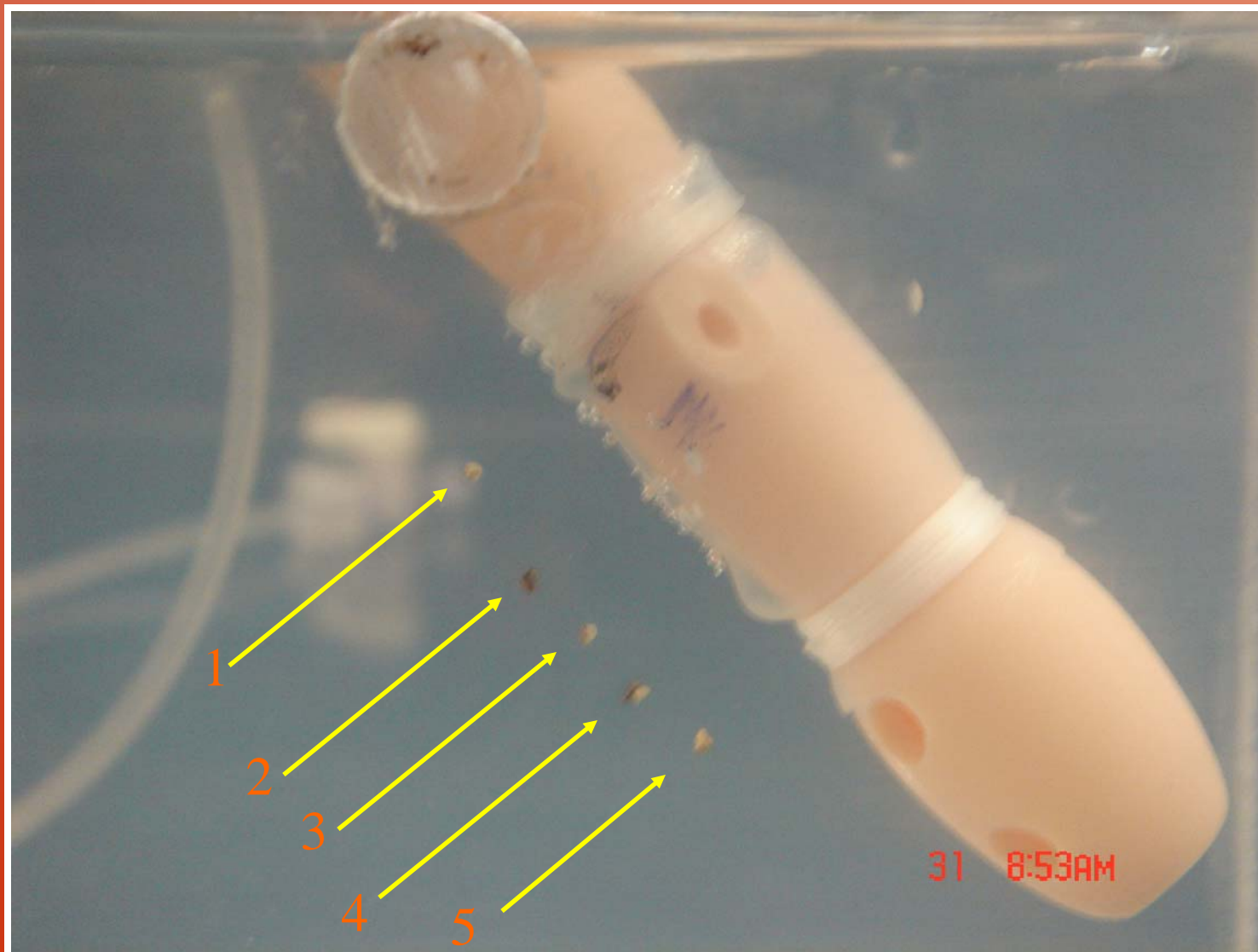
Introduction (2)

- Voids may or may not move tissue uniformly away from the balloon. Tissue may move in the X, Y and Z directions.
- To determine the physical effects of voids on MammoSite treatment, we created a gel phantom with flecks to track tissue movement.
- Various volumes of an inflated balloon represented a variety of air pocket sizes

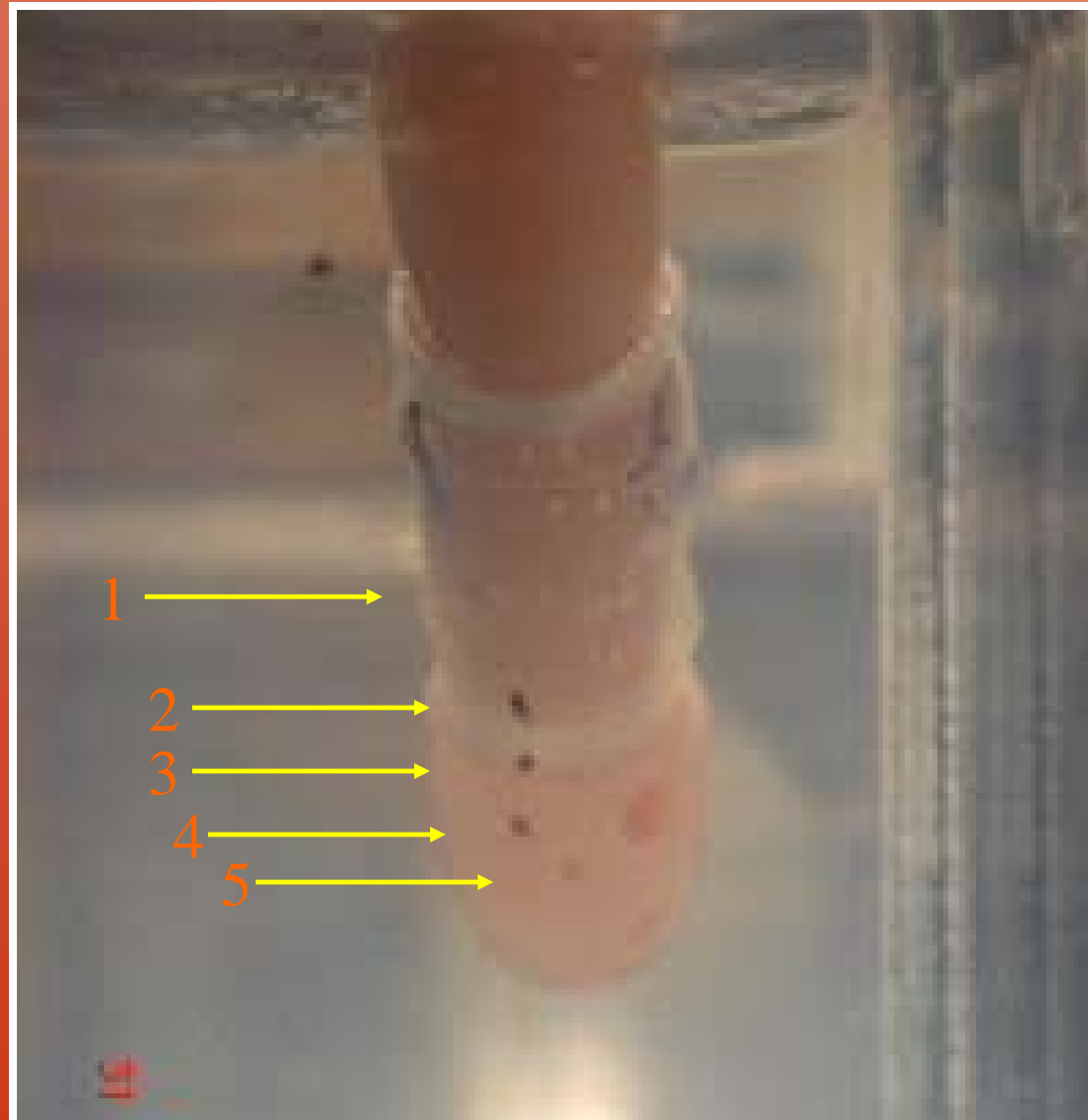
Gel Phantom

- Gel phantom had a Young's modulus approximately that of breast tissue at $E=10$
- Gel was 2% gelatin and 98% water
- Heated solution was set in a Lucite box containing a balloon used in the rectum to immobilize the prostate
- Rectal balloon was used to create the air pockets of various volumes
- Before gel completely set, 5 flecks were inserted approximately 1 cm. away from and along the length of the deflated balloon.
- These flecks represented the tissue at the edge of the 1cm. margin of irradiation.

Side View of Gel Phantom



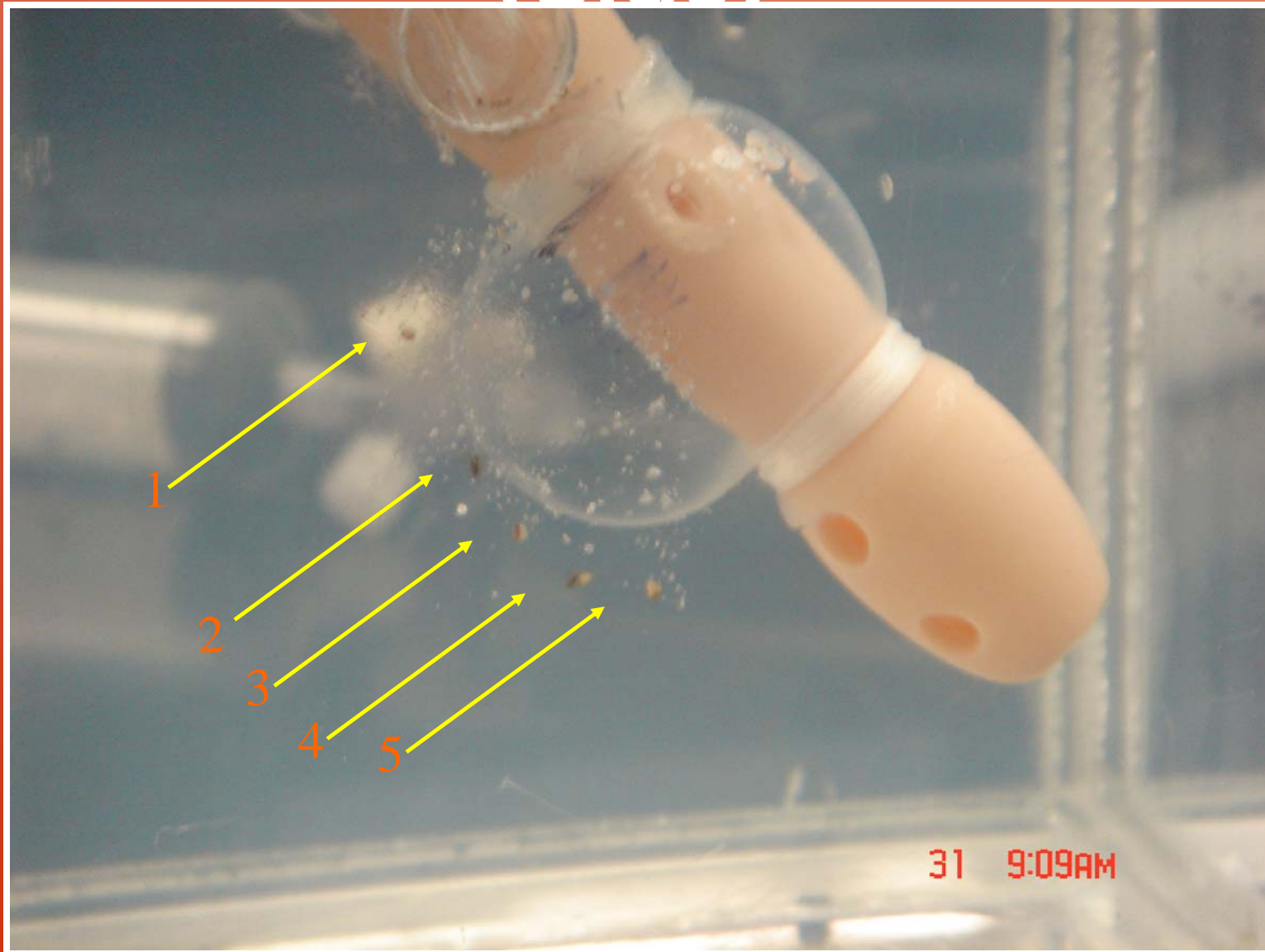
Front View of Gel Phantom



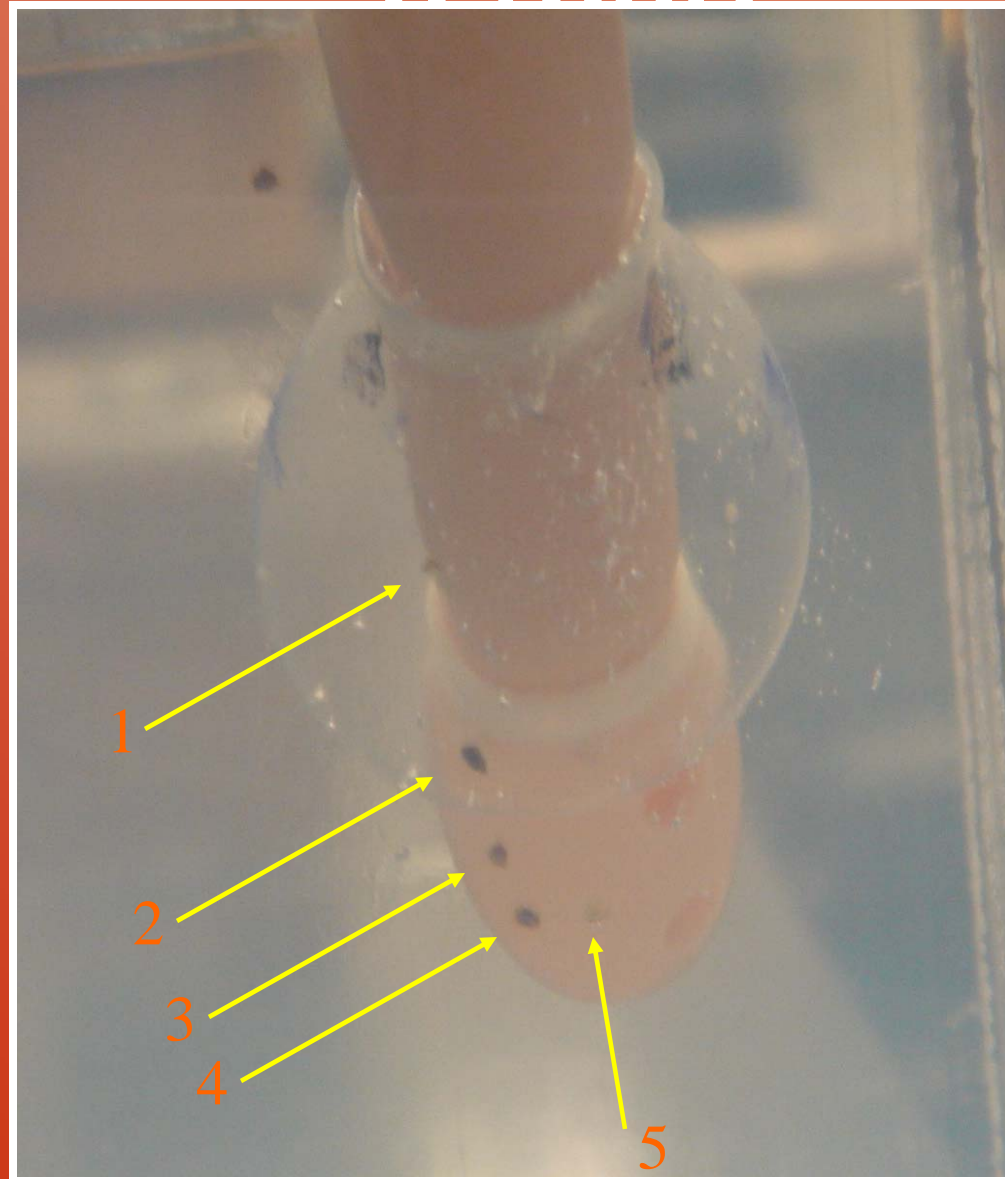
Tissue Movement Measurements

- Rectal balloon was filled with 4 different volumes of water; water was used in order to prevent compression.
- The width of the balloon was measured and a magnification factor created from previous knowledge of balloon width.
- Orthogonal views of fleck movement during inflation of balloon were videotaped, measured, and converted.
- The vector distance was then calculated.
- Actual distance of flecks from deflated balloon was also measured and converted.

Fleck Position after Inflation (Side)



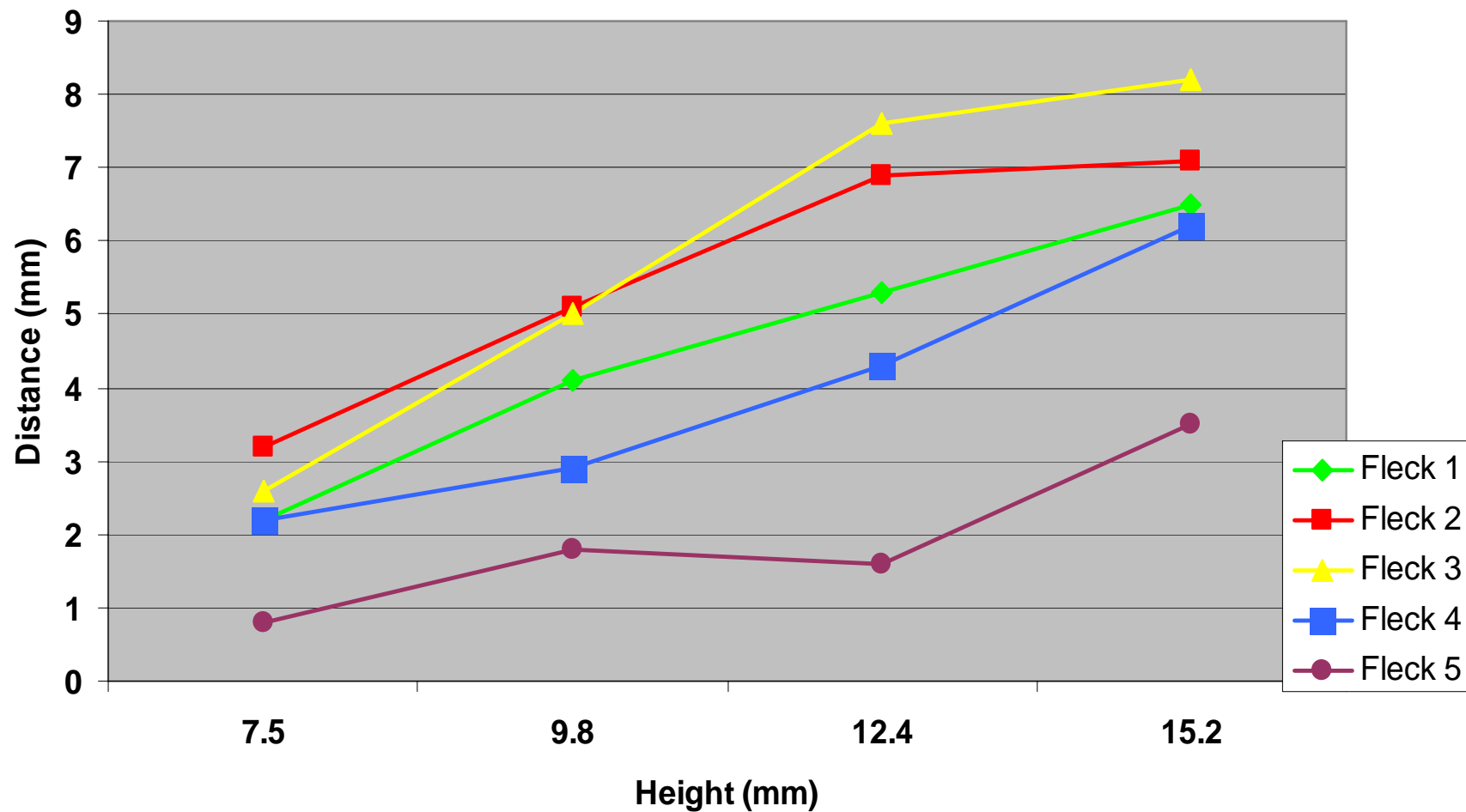
Fleck Position after Inflation (Front)



Fleck Movement Results

Uninflated distance from surface		6.7 mm away	8.2 mm away	7.4 mm away	7.8 mm away	8.5 mm away
Volume (mL)	Height (mm)	Fleck 1 movement (mm)	Fleck 2 movement (mm)	Fleck 3 movement (mm)	Fleck 4 movement (mm)	Fleck 5 movement (mm)
5	7.5	2.2	3.2	2.6	2.2	0.8
7	9.8	4.1	5.1	5.0	2.9	1.8
10	12.4	5.3	6.9	7.6	4.3	1.7
13	15.2	6.5	7.1	8.1	6.2	3.5

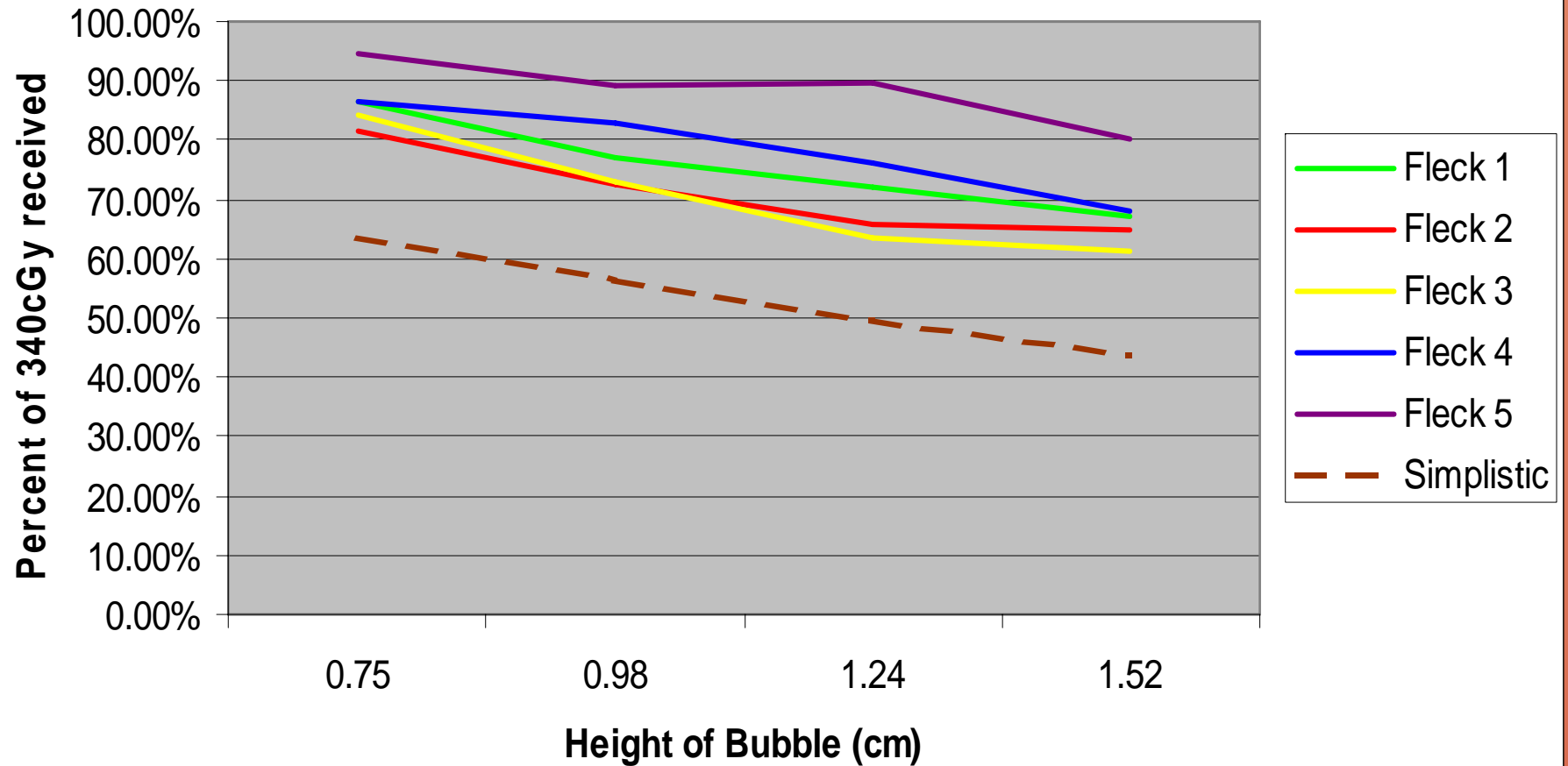
Fleck Movement vs. Height of Balloon



Discussion

- For the case of the 2cm diameter applicator with the simulated breast tissue, we can find that . . .

Percent Dose Received vs. Height



Conclusion

- Fleck movement is not as far as the bubble is tall.
- Experiments with more MammoSite like voids can better predict fleck movement.
- Future work may mathematically model fleck movement.
- The effect of voids is definitely less than if tissue movement matched bubble height, but there could still be a significant effect in dose to tissue.