

# Systematic Port Film Measurement Deviations in Breast Cancer Patients Treated with Radiotherapy

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American College of Radiology Annual Meeting  
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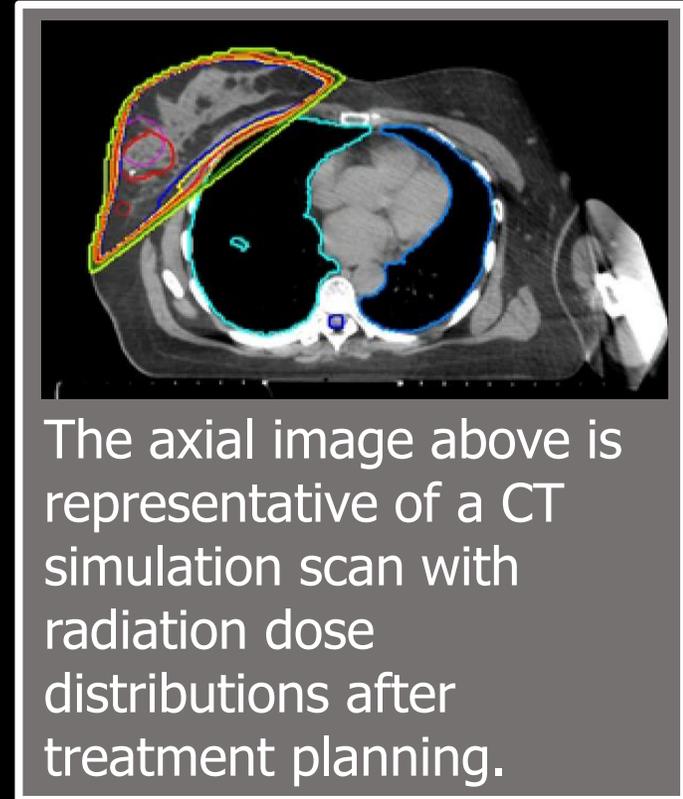
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# Purpose:

- Breast cancer radiation treatments are planned using a CT scan ("simulation").
- Each patient undergoes weekly on-treatment X-rays ("port films") representing the treated radiation fields to evaluate if the radiation plan is being delivered as expected.
- The goal of this project is to review radiographic measurements to assess if there is systematic error introduced by the randomness of the acquisition-in terms of the patient's breathing cycle-of CT scans or port films.

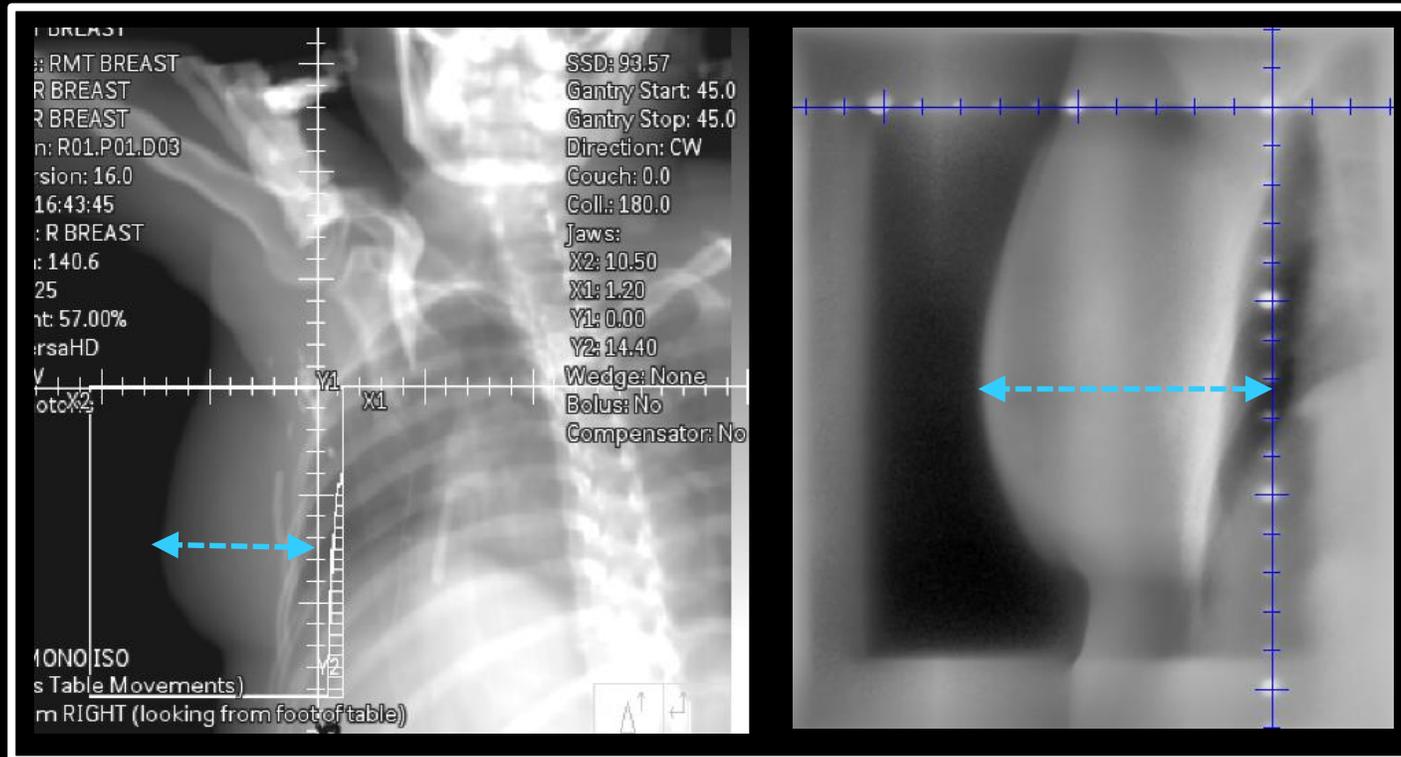


# Materials / Methods

- Sixteen breast cancer patients treated at a single institution from 2016-2018 were reviewed.
- Distances were measured on port films by a single radiation oncologist using a digital ruler calibrated to the graticule on a total of 79 standard weekly port films taken during these patients' treatment courses.

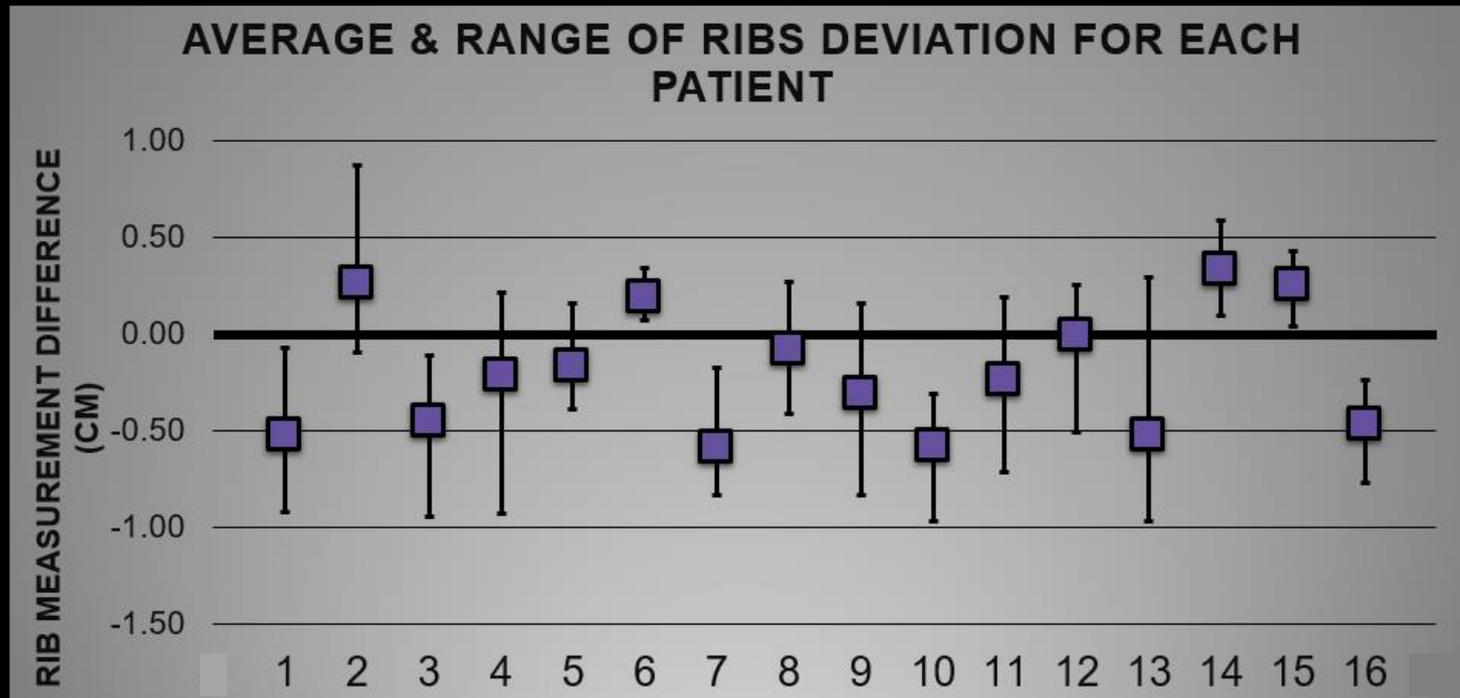
# Materials / Methods

- Distances from the internal treatment field edge (or from the graticule in most cases, for increased consistency) at the central axis to both the inside of the ribs and the edge of the visualized breast tissue were recorded based on the CT simulation and on each port film.



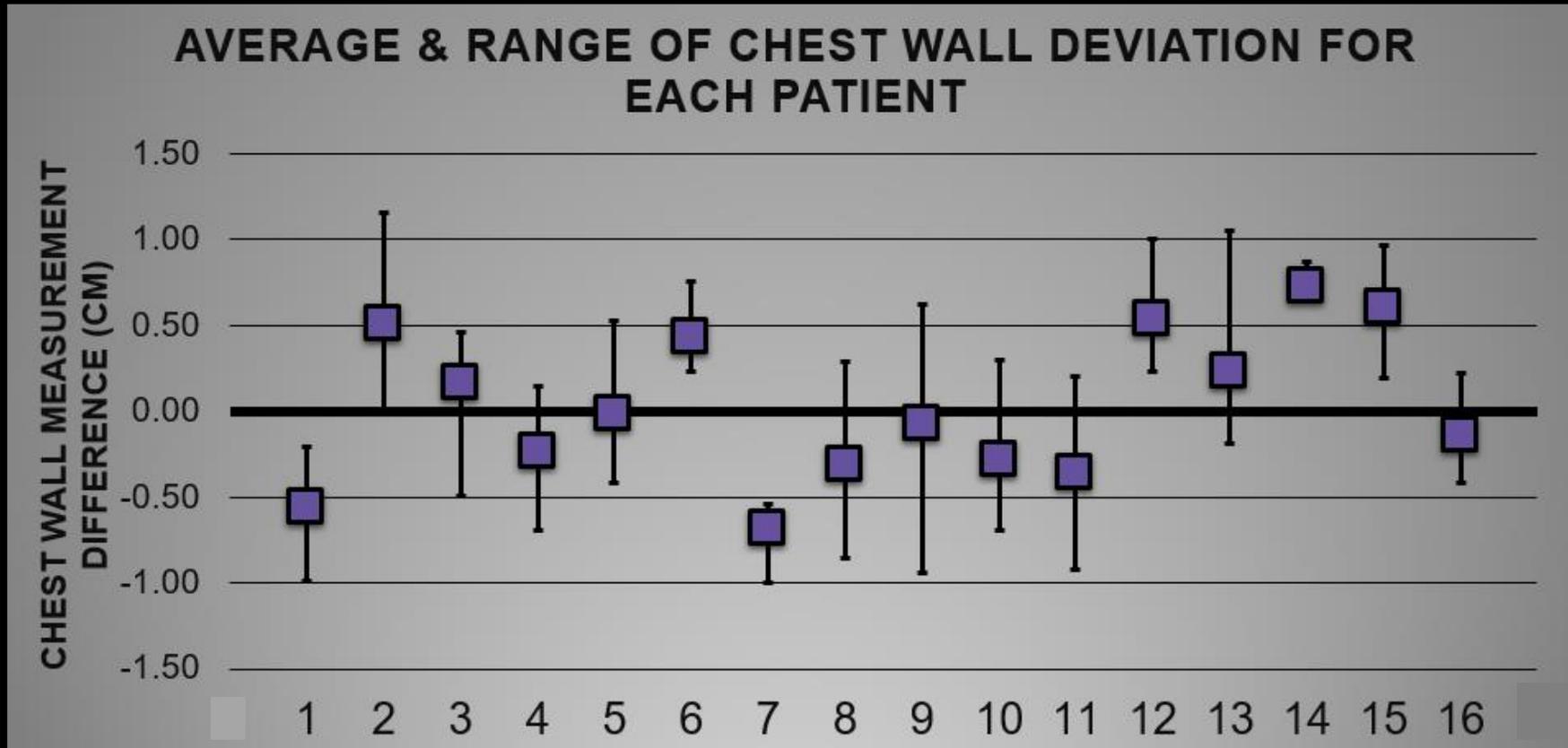
# Retrospective Results

- Illustrated below are each patient's average and range of deviation of daily port film measurements compared to measurements made on the DRRs based on CT simulations. (Medians closely correlated to means.)
- For rib measurements, the absolute average measured deviation from the CT simulation was 3.9mm (median: 3.1mm, range: 0-9.7mm).



# Retrospective Results

- For chest wall / breast tissue measurements, absolute average measured deviation compared to CT simulation was 4.6mm (median: 4.5mm, range: 0.01-11.6mm).



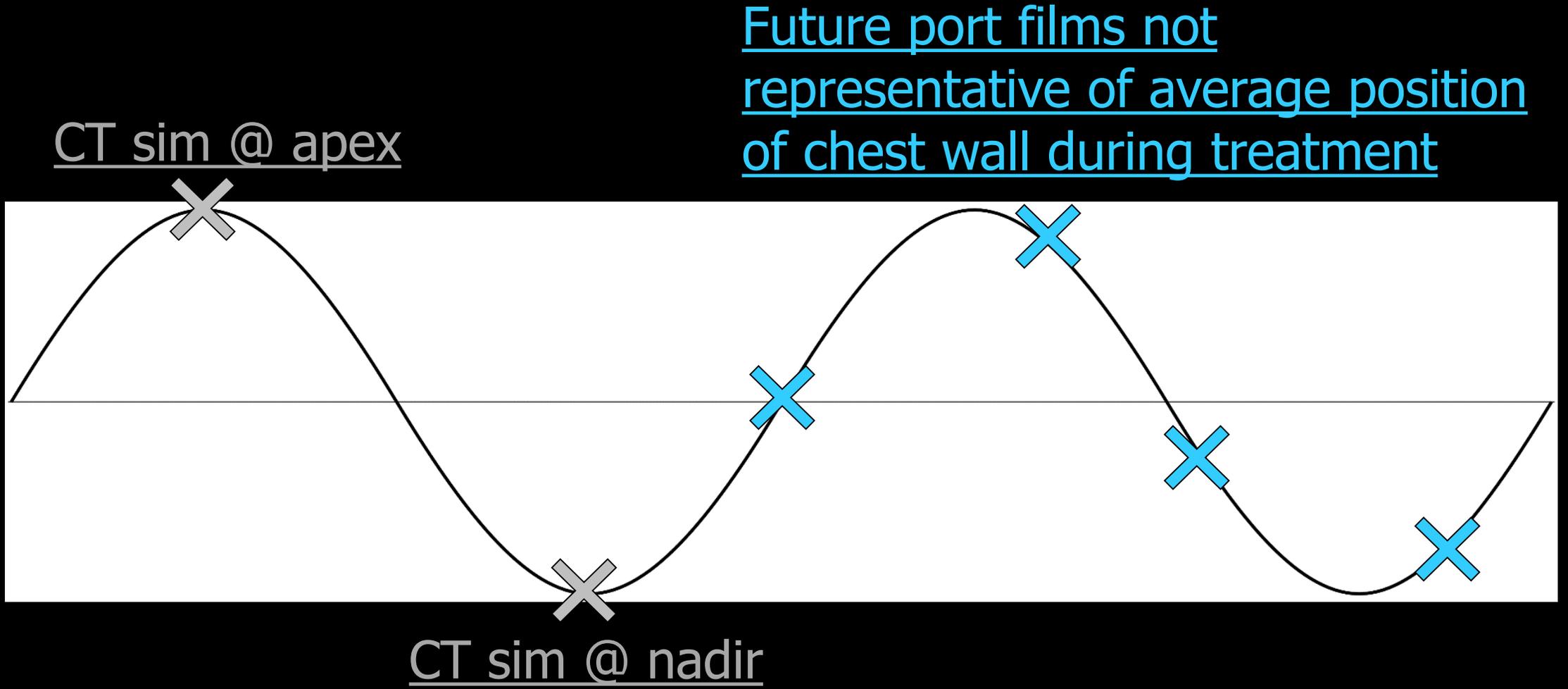
# Retrospective Results

- When reviewing the trends for measured deviations, four (25%) patients had systematically increased most measured distances, and an additional five (31%) had systematically decreased distances when compared to CT simulation measurements.

# Retrospective Conclusions

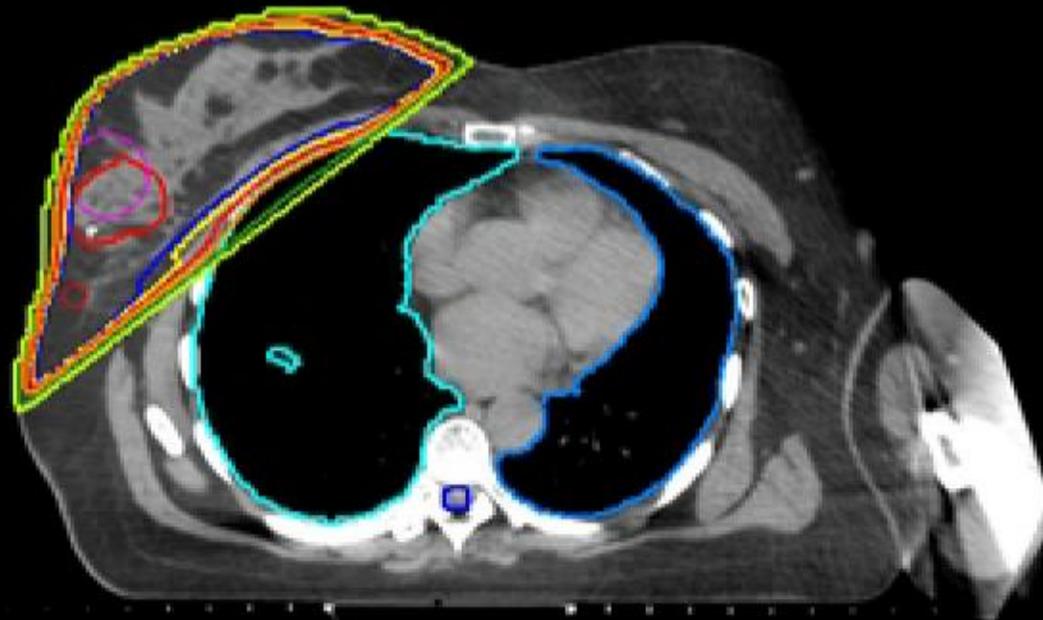
- ▶ While most on-treatment port films **fall within the allowable margin of error** based on radiation planning, not all were representative of the average position of the patient's chest wall during actual radiation treatment.
- ▶ In fact, systematic error **measurable in up to ~50% of patients** may be introduced if the patient unwittingly held her breath at the apex or nadir of her breathing cycle during the planning CT scan, which can translate in to systematic error introduced in the planned treatment course.

Example Respiratory Cycle



# Retrospective Conclusions

- ▶ This error may, in the **worst-case scenario**, lead to **compromised coverage** of the at-risk breast tissue or chest wall.
- ▶ More likely, these deviations could cause unplanned-for hot or cold spots in the radiation treatment fields.

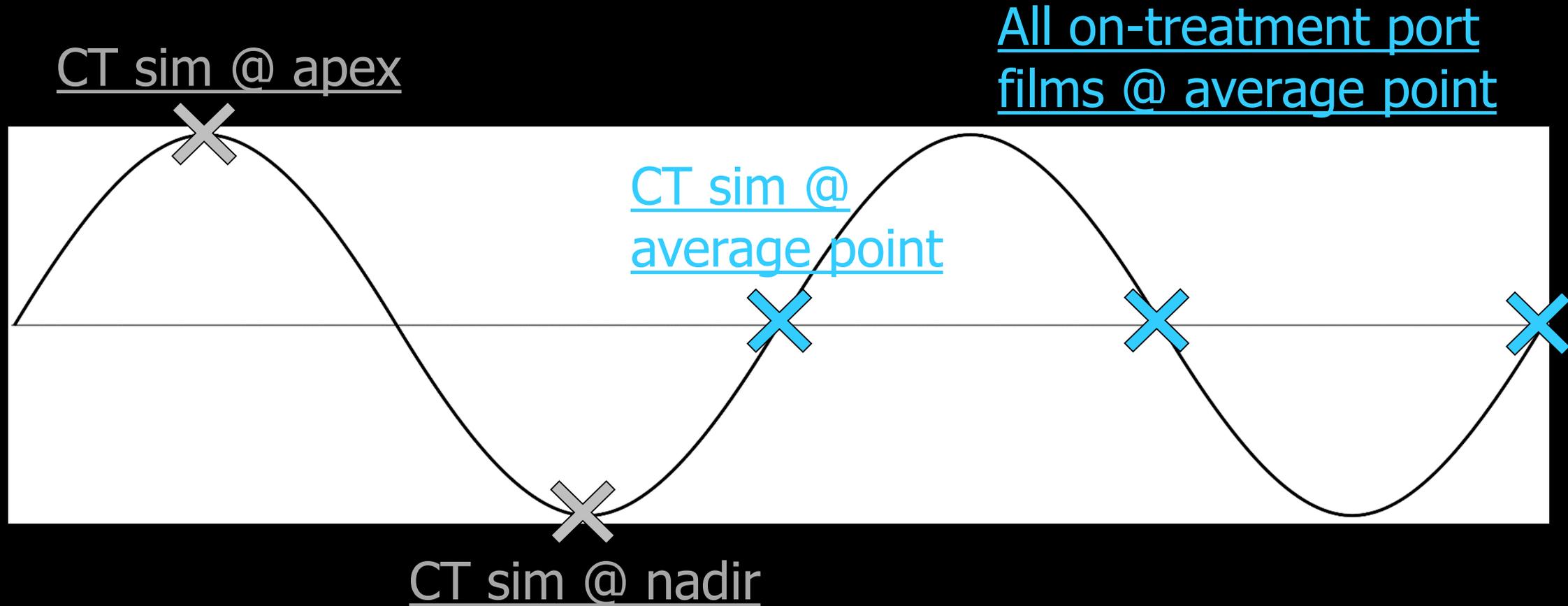


# Proposed Solution: A Prospective Protocol

- Primary Objective:
  - To demonstrate the superiority of using **surface imaging** to combine an ideally gated treatment planning CT and verification images timed to the breathing cycle, quantified as the total within-subject variation of the measured location, the primary outcome, relative to current methods of radiation delivery not using this approach.
- Secondary Objective:
  - To demonstrate the superiority of specialized light-based surface imaging for daily radiation set-up without tattoos compared to standard-of-care methods with regard to the total within-subject variation of the measured location determined by weekly port films during a course of radiation for breast cancer.

# Proposed Solution: Gated CT Sim & Port Films

Example Respiratory Cycle



# Proposed Solution: Gated CT Sim & Port Films

- The superior target volume coverage and increased healthy tissue sparing will theoretically allow better tumor control through **accurate dose targeting** while reducing long-term radiation-induced toxicity.
- Additionally, we will seek to **eliminate the use of permanent tattoos** in our breast cancer patients and thereby decrease the psychological impact of permanent reminder of their cancer treatment.

# Proposed Solution: Gated CT Sim & Port Films

- This prospective protocol **opened to accrual in January 2019**. The target enrollment is 48 patients.
  - The eligibility criteria are intentionally broad to demonstrate applicability to radiation with either tangents or locoregional therapy.
  - Accrual is therefore anticipated to be rapid.
- Full results are forthcoming; presentation of these results are anticipated to define a **new gold standard** for radiation planning and delivery.