

Skin reactions are seen in more than 90% of patients treated with radiotherapy [1] with the severe case of Moist Desquamation (MD) being prevalent in breast patients with large breast size and large skin folds [2]. This study demonstrates a model to predict high risk cases, introducing the potential for future treatment plans to be adjusted to improve patient quality of life.

METHODS

- ❖ Patient cohort: 20 breast patients at high risk for MD based on large skin folds
- ❖ Study: pilot study for early prototype breast support device, with <1mm water equivalent buildup [3]
- ❖ Dose prescriptions: 50Gy/25fractions, 42.5Gy/16fractions
- ❖ Treatment planning technique: tangential pair 6 MV, 10 MV, or 15 MV with field-in-field intensity modulation
- ❖ Skin reactions: The presence or absence of MD was assessed by staff and patients, however exact location within the measured region was not identified. Classification of MD combines both reports.

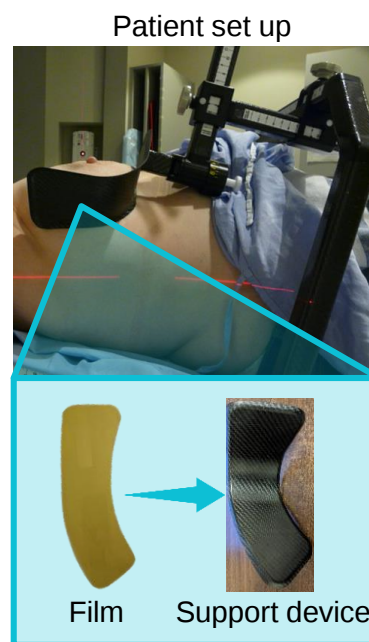


Figure 1: Breast support device on a patient and by itself, with shaped film.

Dose Maps

Gafchromic™ film is placed in the breast support device (See Fig 1) over three treatments per patient, measuring dose in inframammary fold. Average skin dose maps on the inferior breast surface are calculated for each patient and converted to EQD2₁₁ to account for biological effects of two dose prescriptions [4].

F Maps

The metric F (based on predictive metric developed by Lee et al [5]) is applied to the dose maps, determining a value for each voxel that accounts for dose ($D_{i,j}$), cross sectional area (δA_j), and the distance between voxels (d_{ij}):

$$F_i = \sum D_i D_j \delta A_j \frac{1}{e^{a(\frac{d_{ij}}{d_0}-1)} + 1}$$

Parameters $a = 5$ (slope of falloff of the curve), and $d_0 = 20\text{mm}$ (position of the inflection point) are used in the model.

Logistic Maps

Logistic regression was applied to fit the F_i values in MD+ and MD-regions. This associates the F_i values, which account for dose and distance, with the estimated risk of MD.

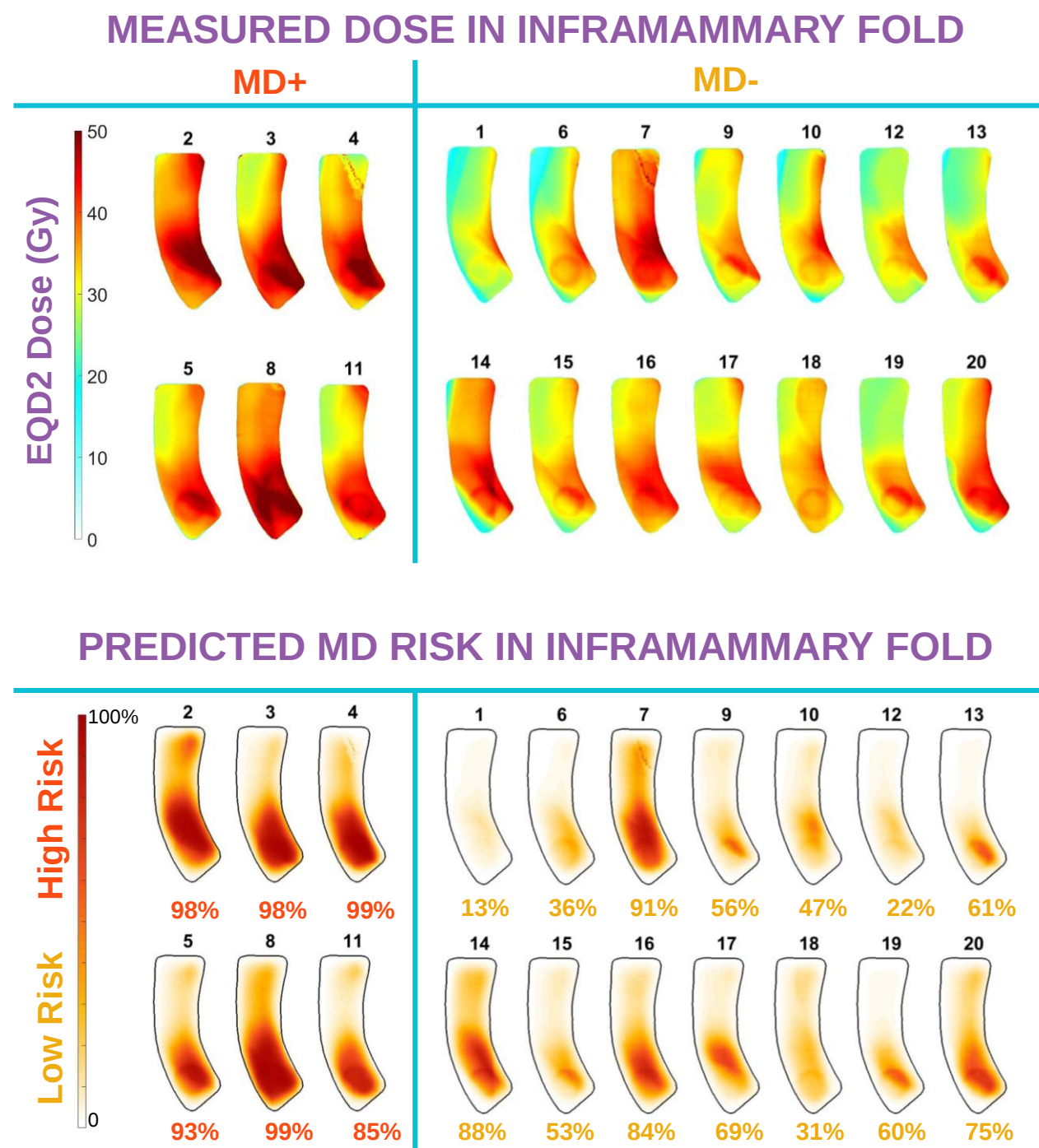


Figure 3: Above) **Dose maps** of patients in EQD2₁₁ dose, separated into patients who did develop MD (MD+) and patients that did not (MD-). Below) **Logistic maps**. Logistic regression is applied to the F maps of each patient, highlighting areas at risk on a scale from 0% to 100%. The maximum risk value is indicated below each figure.

RESULTS

- ❖ Logistic regression fit shown in Fig. 2, with normalized histograms of the frequency of F_i values for the high risk (MD+) and low risk (MD-) known regions.
- ❖ Dose maps and predicted risk maps are shown in Fig 3. The maximum risk values for each patient are identified in the lower panel. Statistical uncertainty on maximum risk value is within 1.4%, however this does not account for the uncertainty of specific location of MD in the input data.

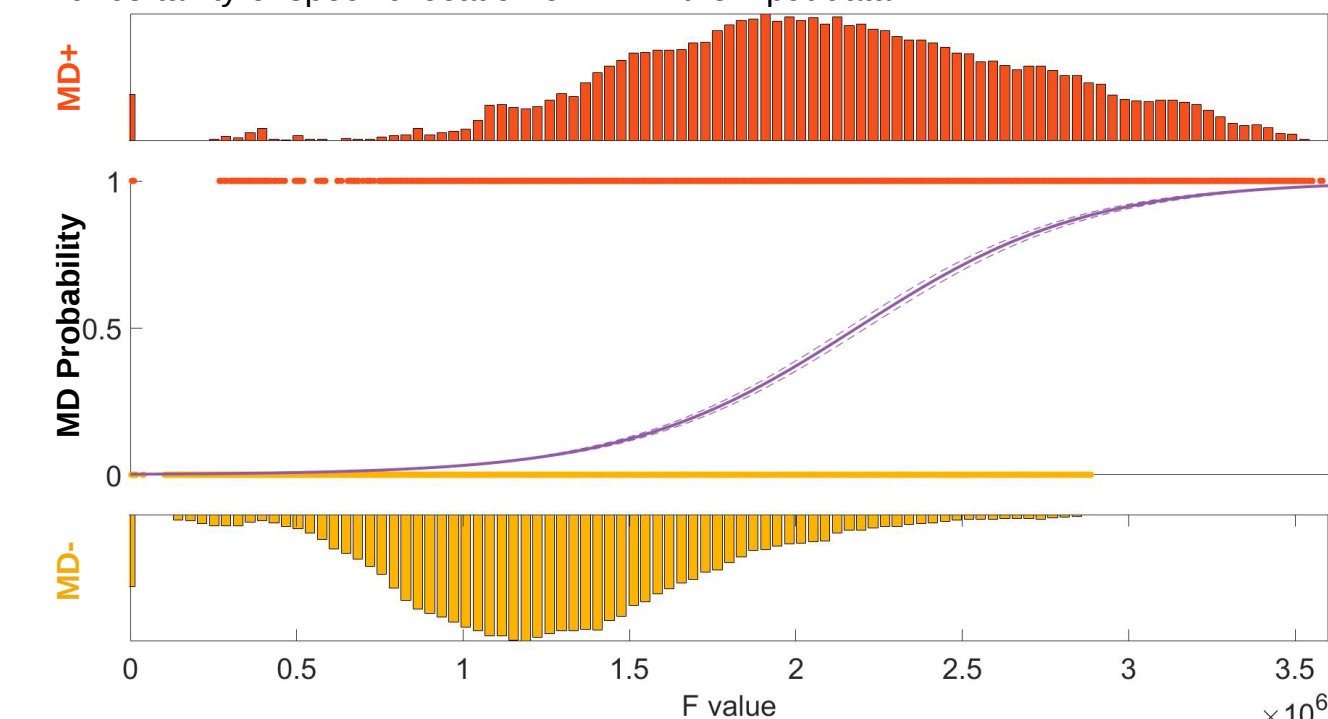


Figure 2: Logistic regression of F maps. Histograms of frequency of F values for MD+ and MD- regions are shown, normalized to maximum occurrence to account for different number of voxels in MD+ and MD- regions. Dotted line indicates standard error on logistic regression coefficients.

CONCLUSIONS

Logistic regression applied to the F metric shows promise in predicting specific regions of skin that are at risk of developing MD in breast radiotherapy. This model is built on a small dataset and expanded testing of this model is underway.

References

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