

# Thermography controlled wIRA-hyperthermia & Low Dose Re-Irradiation in Recurrent Breast Cancer

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## **Abstract**

In combination with low dose radiotherapy, superficial hyperthermia offers the possibility of achieving local control in previously irradiated recurrent breast cancers. Technially, this requires the ability to control temperature distribution in the heated tissue, to adapt heat application to changes in tumor volume, to avoid overheating of normal tissues and to minimize the risk of burns. Our clinical experience of combined hyperthermia-radiotherapy treatments using thermographic monitoring and control in chest wall recurrences is presented.

## **Keywords**

wIRA hyperthermia, breast cancer

## **Methods**

Infrared radiation was applied using a commercial wIRA radiator (hydrosun<sup>®</sup>750). Temperature distribution in the treated region was monitored continuously by an infrared thermography camera (VarioCAM<sup>®</sup> high resolution Jenoptik) mounted to the wIRA radiator and remotely controlled by a computer. Specialized software (Heatcontrol<sup>®</sup>, InfraMedic) was used to keep skin and tumor temperatures constant, whereby a measurement ROI and minimum and maximum temperature values (41-43°C) were selected. Visual inspection of the temperature color-coded images was additionally used for guidance in the correct centering of the heated region and to avoid hot spots. After 45-60 minutes of hyperthermia, re-irradiation was applied with 4-8 MeV-electrons within 1-5 minutes. Hypofractionated RT consisted of 4-6 x 4 Gy 1x/week, up to a total dose of 16-24 Gy.

## **Results**

From 9/2009 to 9/2013, 63 heavily pre-irradiated patients with locally advanced recurrent breast cancer were included in the study. Tumor nodules generally achieved the prescribed maximum skin temperature of 42.5 – 43.2°C with minimum temperatures of 41.5 – 42.2°C. The displayed video thermographs allowed dynamic adaption of the appropriate area of heat applications to subsequent electron irradiation by localizing tumor nodules, cold and hot spots, scars and hyperpigmentation, relative to visible or palpable skin structures. Treatment response was evaluated clinically by MRI and/or PET-CT. 64% CR, 30% PR, 4% NC and 2% PD of 97 treated volumes was achieved. The combined treatments were well-tolerated.

## **Conclusions**

Use of thermography-controlled wIRA-hyperthermia combined with low dose re-irradiation provides good local control of heavily pretreated chest wall recurrences. Dynamic thermography imaging provides not only safe control of heating but also reveals fine details concerning the physiological response to heat absorption. Changes in the on-off heating frequency pattern during hyperthermia have been observed and could provide vascular decompression parameters through model analysis. The remissions achieved so far are very promising and correspond to results found in the literature. This study demonstrates for the first time the possibility of a real-time, online monitoring and control of local superficial hyperthermia all over the whole treatment field.