

# CLINICAL EXPERIENCES USING A CONTACT FLEXIBLE MICROSTRIP APPLICATOR OPERATING AT 70 MHZ FOR EXTERNAL HYPERTHERMIA

Zum Vörde Sive Vörding P. J. †\*, van Wieringen N. †, Wiersma J. †, Oldenburg S. †\*,  
Gelvich E.A. ‡\*, Bel A. †, Crezee H. †\*,

†Radiotherapy department, Academic Medical Center, Meibergdreef 9, PO Box 27000,  
Amsterdam, The Netherlands, ‡ Department of Medical Electronics, Federal State

University. Enterprise Research and Production Corp. 'Istok'. 141190, Fryazyno, Moscow  
Region, Russia,

## Introduction

At our department occasionally patients are presented with a superficial tumor with extension in depth beyond the range of the regular superficial CFMA-434 applicator operating at 434 MHz. For this group of patients the Contact Flexible Microstrip Applicator operating at 70 MHz (CFMA-70) was introduced. This applicator combines flatness, lightness and flexibility with a high penetration depth in the range generally used for regional hyperthermia systems. The objective of this study is to evaluate the performance of the CFMA-70 and its applicability for superficial hyperthermia on deep seated tumors.

## Method

So far 6 patients have been treated with the CFMA-70 applicator. All patients selected had advanced primary or recurrent breast cancer and were previously treated with radiotherapy, chemotherapy and in three cases an ablatio mamma. The depth of the tumors was 4 cm or more, too large to be treated adequately with the CFMA-434 applicator. The aim was four treatments at a tumor temperature between 41 and 43°C. Temperatures were measured with multi-point thermocouples, with 2 to 4 non-invasive thermocouples placed at the skin below the applicator and up to 3 invasive thermocouples. The geometry of the volume to be heated was considered to be difficult to treat in all patients as in most cases the breast or tumor was vast, irregular and quite rigid.

## Results

The penetration depth of the EM-field appeared to be sufficient and the applied power levels, on average 220 W, and were well below the maximum level of 300 W. An additional flexible bolus was placed on the breast to reduce power reflection as it proved difficult to conform the shape of the antenna to the shape of the breast. The temperature distributions were rather inhomogeneous and  $T_{50}$  was rather low:  $T_{10}$ ,  $T_{50}$  and  $T_{90}$  of the invasive tumor temperature points averaged over all patients are 41.0°C, 39.6°C and 38.5°C respectively.

## Discussion & Conclusions

Based on the extended penetration depth of the CFMA-70 most benefit is expected for patients with large superficial tumors with a depth exceeding 4 cm, too large to be treated adequately with the CFMA-434. However, relatively low average temperatures are achieved in the cases presented. This was caused by the irregular shape of the target and by occurrence of hot spots which significantly limit the applied power (mainly below the ends of the applicator where the normal E-field component is largest).

Alternative applications for which this applicator may be useful: as the SAR pattern of this applicator is insensitive to the bolus thickness it may act as a replacement of the CFMA-434 for situations where a uniform bolus thickness is difficult to achieve (e.g. uneven surfaces). Also, the CFMA-70 may enable treatment of (deeper) tumors located beyond the human trunk at sites that are difficult to approach using the less flexible and bulky phased array systems.

---