

# ASSESSMENT OF THE POWER ABSORPTION PATTERN IN THE NECK FOR A HYPERTHERMIA APPLICATION

Paulides MM<sup>(1)</sup>, Vossen SHJA<sup>(2)</sup>, Zwamborn APM<sup>(3)</sup> and Van Rhoon GC<sup>(4)</sup>

<sup>(1)</sup> *Erasmus MC - Daniel den Hoed Cancer Center, Department of Radiation Oncology, Section Hyperthermia PO box 5201, NL-3008 AE, Rotterdam, The Netherlands, E-mail: M.Paulides@ErasmusMC.nl*

<sup>(2)</sup> *The Netherlands Organisation of Applied Scientific Research, The Hague, The Netherlands. E-mail: Stefan.Vossen@tno.nl*

<sup>(3)</sup> *As <sup>(2)</sup> above, but Email: Peter.Zwamborn@tno.nl*

<sup>(4)</sup> *As <sup>(1)</sup> above, but Email: G.C.vanRhoon@ErasmusMC.nl*

## Background

Patients with advanced cancer in the head and neck (H&N) have a dismal prognosis and loco-regional control for this site still poses a major therapeutic challenge. Valdagni *et al.* [1] demonstrated in a phase III trial that when hyperthermia (HT) is added to Radiotherapy (RT) for superficial head and neck tumours a significant increase in local control is achieved. The development of a specific designed, multi-element, applicator was initiated to extend the applicable area for HT from superficial to deep tumours.

## Purpose

Investigation of the ability to deposit RF-energy centrally in the neck as a function of number of antennas and operating frequency.

## Materials & Methods

Power absorption (PA) distributions in a generalized and a realistic model of the head and neck anatomy are calculated, where the head model is irradiated by a circumferential array of dipole antennas. The PA distributions corresponding to different set-ups are visualised and analysed using the amount of power absorption in the target and neck, where the target region is a brick-shaped volume in the centre of the neck at the height of the antenna ring.

## Results

The PA distributions indicate an optimal focussing ability of the set-ups, i.e. the ability to direct energy efficiently into the target region, around 433 MHz. Lowering the frequency to 100 MHz and 144 MHz, while maintaining the antenna positions, leads to superficial absorption only whereas increase of the frequency results in multiple focal regions within healthy tissue. The focussing ability of a setup at 433 MHz increases significantly by increasing the number of antenna elements.

## Conclusion

The optimal frequency is highly dependent on the size of the target volume thus a single optimum is hard to define. From the findings of this study and the fact that 433 MHz is an ISM<sup>1</sup> frequency at which high power amplifiers are commercially available. From the numerical results that are presented it is our opinion that it is justified to continue our investigations at 433 MHz. The actual number of antennas and use of multiple rings of antennas are subject of further research, where an optimum is expected around six to eight antennas per ring.

## Acknowledgement

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## References

[1] Valdagni R and Amichetti M. Report of long-term follow-up in a randomized trial comparing radiation therapy and radiation therapy plus hyperthermia to metastatic lymphnodes in stage IV head and neck patients. *Int. J. Radiat. Oncol. Biol. Phys.* 1993; 28: 163-169.

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<sup>1</sup> ISM frequencies: these are frequencies allocated for applications in Industry, Science and Medicine. In most European countries they are: 27.12, 433 and 2450 MHz. In the USA 433 MHz is replaced by 915 MHz.