Wireless therapies:

staff and patient safety regarding inhomogeneity of electromagnetic radiation distribution in Physiotherapy units

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Abstract—Micro-wave diathermies (MWD) are a kind of wireless therapeutic systems that are in use for some decades now in all physiotherapy rooms according to national facility establishment regulations. Recently, a probable correlation between the use of diathermies in physiotherapy and health problems has already reported. It is additionally obvious that diathermy devices probably lack validity as working time passes introducing the need of control/resets of the device by qualified personnel in order to maintain its effectiveness in sessions and really withdraws the energy output the therapist asks for. A number of field measurements have already been found over the ICNIRP and National limits in our previous work have also been reported. Furthermore, in this paper we focus on over limited values that have been recorded at different distances, angles and levels above ground, in physiotherapy rooms including objects between transmitting and measuring devices such as beds, chairs and other medical equipment in various formations, following a quality control protocol that has already introduced in a number of units in Western Greece. All the procedure has been conducted through wireless communication between measuring unit and our laboratory center. Serious concerns about not only for staff but also for patient safety regarding the inhomogeneity of electromagnetic radiation (EMF) distribution emitted from MWD devices, are also discussed.

***Keywords*-Wireless therapies, *Physiotherapy*, *field inhomogeneity*, safety protocol**

I. INTRODUCTION

Microwave diathermy is a form of radiofrequency radiation used therapeutically by physiotherapists and other health professionals for cancer wireless treatment. Recent research has documented serious concerns among physiotherapists regarding their exposure to electromagnetic radiation in physiotherapy departments, in particular using short-wave and microwave diathermies (fig. 1). To assess occupational exposure to non-ionizing radiation, microwave (MW), devices were analysed. According to a number of researchers, a probable correlation between the use of diathermies in physiotherapy units and health problems as heart disease for men and abortions for women has already reported [1-5]. Large differences have already found in stray field intensities were found for MW applicator in one of our preliminary studies [6]. According to published results although most areas show substantially limited levels of occupational exposure to electromagnetic fields for physiotherapists, a number of cases of over-occupational exposure limits do exist [1-6].

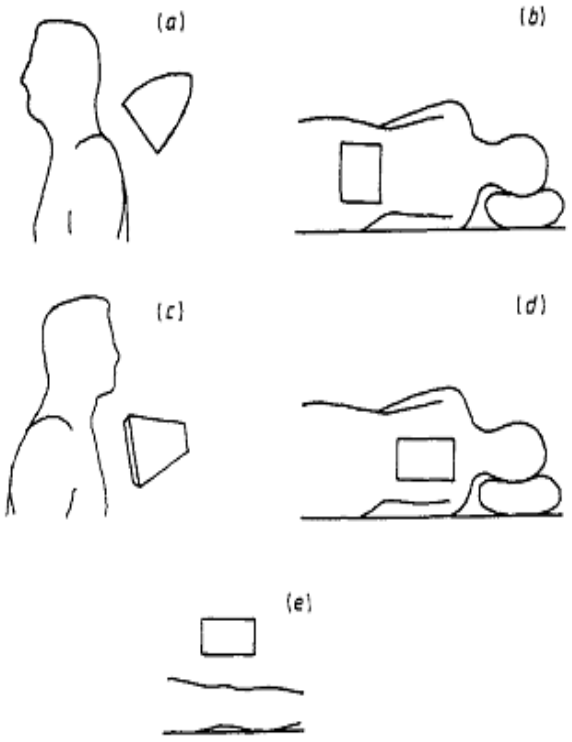

Figure 1: Wireless *MWD application for rehabilitation.*

In a recent review Sarwar SS. & Farrow A. have given an overview within searching extension [7] on this field for both Short WD as well as MWD devices. As we can observe our previous studies we agree with their conclusion, that more measurements, actions, claims, procedures, demands, etc must be applied and a standardized experimental procedure have to be established in order to have an accepted radiation safety procedure in use when MWD are used for therapy [6, 7]. In Western Greece a novel quality control protocol for MWD equipment that has already introduced by our lab is used in cooperation with the Regional Physiotherapy Union in order to

MOBIHEALTH 2014, November 03-05, Athens, Greece

DOI 10.4108/icst.mobihealth.2014.257233

improve staff as well as patient safety that working or treated in the same room when such devices are on. According to the previous we use ICNIRP as well as Greek Atomic Committee legislation for comparison with both occupational and general public EMF exposure limits [6]. At present our target is to apply more details or modifications on our safety procedures already in use. One of the most important factors when devices are working in GHz band is the great wave length emitted in a considerably small room. In this paper EMF measurement because of stray field inhomogeneity in a physiotherapy room is discussed in order to a clearer view for additional safety control suggestions.

II. MATERIALS AND METHODS

Following our recently introduced safety protocol ten (10) MWD devices working in 30 – 40 m2 rooms, have been examined. Four of selected diathermy devices lacked working validity because of different mechanical or electronic dysfunctions recording wrong output values or time controls, introducing the need of resets of the devices by qualified personnel in order to maintain effectiveness in treatment sessions and affecting the real therapeutic energy that physiotherapist asked [7]. Through the last part of the safety procedure we applied field measurements in order to certify first the reliability of the MWD output through repeated measurements and increasing the output radiation power a large deviation of field power values (in V/m) as well as at a specific output value field strength at 5 different angles and 6 distances with 0.5 m step, at three levels above ground in the working room were measured (fig. 2).

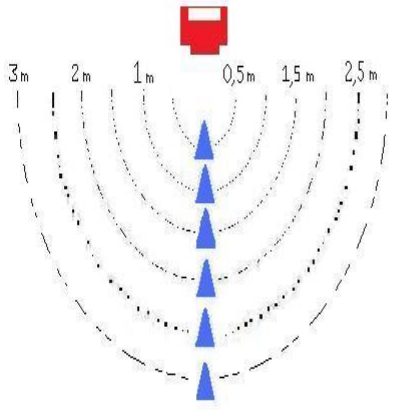

Figure 2: *MWD and measurement devices at different distances and angles.*

Measurements taken at consoles and environmental mapping at 0.5 to 3 m from MWD applicator always in comparison with ICNIRP proposed exposure limits and finally accepted in European Directive 2004/40/EC with 137 V/m for occupational and 61 V/m for general public limits in GHz band. All field strengths were measured with a digital Electromagnetic Field Spectrum Analyser measurement device (Narda SRM 3000, Germany), connected to specific probe detector within the same frequency range. The 6 measured devices used as they operated for 6 minutes at a constant average power of 200 Watt at 2.45 GHz, 10 cm over a specifically introduced fandom placed on a wooden chair directly under MWD applicator fixed at a height level of a medium human shoulder following our protocol considerations [5, 6]. There were recorded values in each physiotherapy unit, including objects between transmitting and measuring devices such as beds and chairs in various formations [8-11]. A special web mobile application has been developed in order to possible a wireless on-line communication between measuring unit/team a workstation in our Health Physics Lab and Health Informatics Sector. Through this application that produced for specific operation systems (Linux/IOS/Android) all data as well as unit settings can be seen from the lab center on-line.

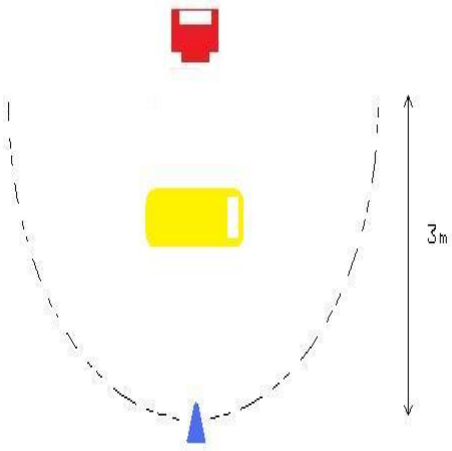

Figure 3: *MWD and measurement devices with different objects between them.*

III. RESULTS

In all 6 physiotherapy rooms examined a number of field measurements found over the ICNIRP (EU) and National limits for both occupational and general public values [12, 13]. Examples are presented in Fig. 3, and in Table 1. We considered staff for occupational exposure and patients that can be treated at the same time in the same room for general public exposure.

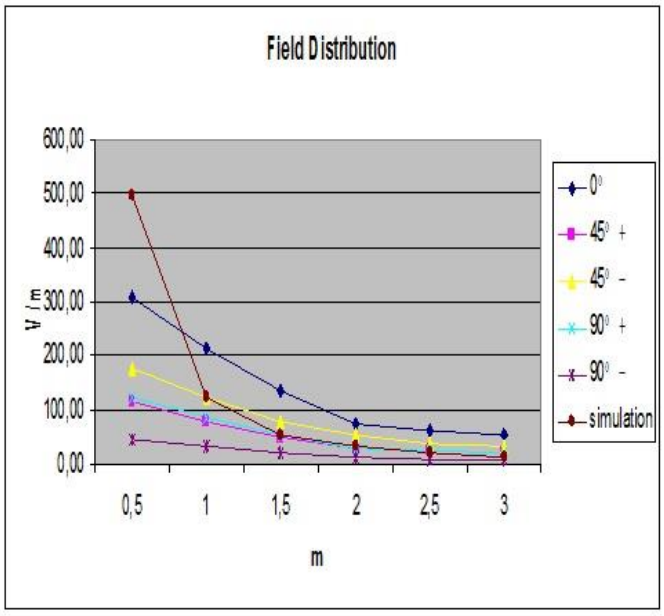

Figure 4: *Typical presentation of field distribution (values in V/m) of MWD*

According to our result levels in front of MW therapy applicators decreased rapidly with distance but this does not always occur in work environments where nearby numerous metal structures may reflect or perturb electromagnetic fields in GHz band. Consequently safety recommendations given by the manufacturers and literature for minimum distances from the working device, cannot be applied to all room formations (fig 2). Further work need to be done for verification under different circumstances [6, 7]. Further protocol improvements as well as shielding solutions have to be introduced.

Table 1: *Typical example of field inhomogeneity (values in V/m) in front of MWD device emitting 200 Watts (in red values above Greek Limits for occupational and yellow above general public exposure).*

distance (m)	0°	45° +	45° -	90° +	90°
0,5	310,00	114,70	176,70	124,00	46,5
1,0	213,80	79,11	121,87	85,52	32,07
1,5	133,75	49,49	76,24	53,50	20,06
2,0	75,00	27,75	52,75	30,00	11,25
2,5	62,50	23,13	35,63	25,00	9,38
3,0	55,04	20,36	31,37	22,02	8,26

IV. CONCLUSIONS

A number of diathermy devices in use probably lack validity as working time passes introducing the need of controls and resets of the device by qualified personnel in order to maintain its effectiveness in sessions and really withdraws the energy output. Field significant deviation and values above limits, suggest the need for specialized study in landscaping treatment as an important part of a safety procedure [6]. These studies require strict procedures and qualified personnel for consideration of all necessary for quality and safety controls in order to provide every possible solution to protect physiotherapists as well as patients under different treatment procedures from electromagnetic radiation [14, 15]. National and International health professional bodies could also develop directives for non-ionizing radiation exposure in therapy Units [6].

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