

Normative Values for Inter-Hand Tissue Dielectric Constant Ratios with Possible Applications in Post Mastectomy Lymphedema

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Ratio

p-value

0.452

Background

Early detection and tracking of breast cancer treatment-related lymphedema has been helped by quantitative assessment methods and parameters including bioelectrical impedance spectroscopy (BIS) and tissue dielectric constant (TDC). Such measurements are evaluated with respect to inter-arm differences or ratios that, when exceeding specified thresholds, are suggested of lymphedema. Specific threshold ratios depend on the assessment method and have been reported for arms. However, there is far less information available on thresholds to assess lymphedema that manifests in at-risk hands and essentially nothing is known about TDC ratios in healthy hands. Such information is essential to establish reference values from which lymphedema threshold TDC values may be estimated.

Measurements Illustrated



Objective

The specific aim of this research was to determine inter-hand TDC ratio thresholds that manifest in at-risk hands and healthy hands of both young and mature women.

Methods

After signing an IRB approved informed consent, 70 women (35 YOUNG) and 35 MATURE) participated. YOUNG were < 30 years of age (18-29) years, 25.1 \pm 2.2) and MATURE were \geq 50 years (50–87 years, 67.3 \pm 9.9) with all data given as mean \pm SD. MATURE had a significantly greater body mass index (BMI) than YOUNG (28.9 \pm 5.4 vs. 23.7 \pm 3.7, p<0.001). Participation required that there be no history of hand or arm trauma or edema and no skin condition affecting the hand area. Three participants from each group were self-reported left-hand dominant, all others self-reported right-hand dominant. Measurements were done with a subject supine on a padded examination table with arms resting at their sides, palms down. A target site on each hand dorsum within and near the middle of the web space was marked (Fig. B) and TDC was measured in triplicate with a MoistureMeterD (Fig. A) which was placed in contact with the skin for 6-7 sec. at 300 MHz to approximate skin depths of 2.0 mm -3.0 mm. A built-in pressure sensor allowed for reasonably consistent applied pressures to be achieved.



Results

The major experimental results of this study (Table 1) show that TDC values measured on the dominant hand dorsum of MATURE women are less than those measured on the dominant hand of YOUNG women (p<0.008) and also on the non-dominant hands (p<0.002). These MATURE related reductions correspond to 14.1% in TDC for the dominant hand and 15.1% for the non-dominant hand. However, despite these significant differences in absolute values between age groups, the dominant to non-dominant TDC ratio was similar for YOUNG and MATURE (1.017 \pm 0.109 VS. 1.035 \pm 0.090, p= 0.452). The distribution of TDC ratios for all 70 women is shown in (Fig. C) along with a superimposed Gaussian distribution. The overall mean and median of the distribution are 1.026 and 1.027 respectively with a SD of 0.100. For this distribution a plausible conservative reference threshold TDC ratio, above which would suggest the presence of hand lymphedema, is its mean value plus 2.0 SD which equals 1.226 and practically can be rounded to 1.23. For the presently measured values no subject's ratio exceeds this value and only one subject (1.4%) has a ratio greater than 1.200.

Main Outcomes



Conclusions	Dominant Hand TDC Value			non-Dominant Hand TDC Value			Dominant/Non-Dominant	
The aim of this research was to provide a practical way to detect and	YOUNG	MATURE	p-value	YOUNG	MATURE	p-value	YOUNG	MATURE
Based on the present measurement set, an age-independent inter-hand TDC	42.7 ± 9.0	36.7 ± 9.2	0.008	42.0 ± 8.2	35.5 ± 8.4	0.002	1.017 ± 0.109	1.035 ± 0.090
threshold ratio of 1.23 emerges as potentially useful for lymphedema detection. Despite variance in absolute TDC values among women of various ages, the ratio appears to be relatively consistent. This is a good initial start threshold that is useable in future clinical and research	Table 1. Hand TDC Values							
assessments.								