Title:Get It Right the First Time, Measure Twice, or Third Time's a Charm?Single vs. Multiple Tissue Dielectric Constant (TDC) Measurements

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Background: Tissue dielectric constant (TDC) measurement devices transmit an electromagnetic wave through a coaxial line onto an open-ended probe that is placed in contact with skin and, while a major portion of the wave is absorbed by tissue water content, a remaining fraction is transmitted back into the line. The device can then calculate a dielectric constant that is proportional to skin tissue water. TDC measurements are used to estimate skin water content changes due to medical conditions such as breast cancer treatment-related lymphedema and lower extremity edema. Most prior studies have used triplicate TDC averages because the suitability of single measurements was unknown. If the accuracy of one measurement was found to be adequate, then some clinical measurement time could be saved.

Objective: The purpose of this study was to determine the differences in absolute and relative TDC values based on one measurement per anatomical site versus averaging duplicate or triplicate values.

Methods: This study was approved by the NSU institutional review board and all participating subjects signed an approved consent form. Measurements were done in a dedicated research room on the HPD campus. An equal number of female (n=25) and male (n=25) subjects with no history of upper or lower extremity edema or lymphedema were recruited for participation. The studied group's average age (mean ± SD, N=50) was 30.6 ± 13.4 with a range of 18 to 70 years. Triplicate TDC measurements were made bilaterally at five anatomical sites representative of lymphedema development areas; anterior forearm, hand palm, lateral calf, medial calf and foot dorsum. TDC values obtained with single measurements were compared to duplicate and triplicate averages at each site (N=100). TDC dominant-to-nondominant side ratios (N =50) were also compared.

<u>Results:</u> The triplicate average TDC values for forearm, hand, lateral calf, medial calf and foot measurements were, respectively, 31.1 ± 4.4 , 42.7 ± 8.2 , 40.1 ± 6.7 , 34.4 ± 5.3 and 31.6 ± 5.3 . The average percentage difference between these triplicate values and those obtained with a single measurement was less than 0.75% at all sites with a maximum SD of 4.7% at the medial calf and a minimum of 2.2% at the forearm. Dominant-to-nondominant side TDC ratios using triplicate values were respectively 1.013 ± 0.090 , 1.019 ± 0.112 , 1.019 ± 0.163 , 1.052 ± 0.134 and 1.029 ± 0.108 . Ratios using single values differed by, at most, 1.5%.

<u>Conclusion</u>: The results of this study suggest that single TDC measurements or dominant-tonondominant side ratios based on single TDC measurements can be utilized if a deviation from triplicate averages of $\pm 5\%$ or $\pm 1.5\%$ is acceptable, respectively. Thus, unless small changes are needing to be tracked, much clinical time can be saved by using single measurements.