

Tissue Dielectric Constant Measurements as a Way to Assess  
Skin Tissue Water in Persons with and without Diabetes Mellitus  
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**Background:** Measurement of the local tissue dielectric constant (TDC) at a frequency of 300 MHz via the open-ended coaxial probe method is a useful non-invasive measure to quantify relative local tissue water. The method permits assessment and tracking of changes in skin tissue water (STW) in many situations including lymphedema and other edematous conditions. The operating principle depends on the direct relationship between TDC values and fluid content contained within skin including contributions of epidermal, dermal and vascular tissues.

**Objectives:** Our specific aim was to use TDC measurements to determine if STW in persons with diabetes mellitus (DM, type II) is less than in persons without DM (NO-DM). Our motivation stems from the fact that although microvascular and other DM-related skin changes may cause skin dryness and other complications there is no data describing or otherwise evaluating possible DM vs. NO-DM differentials in skin tissue water.

**Methods:** TDC was measured bilaterally on forearm and on foot dorsum of 18 persons with DM (5 male/13 female) and 18 persons (6 male/12 female) without DM. TDC Measurements were made in triplicate with subjects supine to skin-depths of 2.5, 1.5 and 0.5 mm. NO-DM and DM groups did not differ by age ( $54.2 \pm 18.4$  vs.  $62.7 \pm 12.5$  years,  $p=0.21$ ) or BMI ( $28.4 \pm 4.2$  vs.  $29.9 \pm 5.2$  Kg/m<sup>2</sup>,  $p=0.36$ ). DM duration was  $133 \pm 132$  months and average HbA1c was  $7.4 \pm 1.4$ .

**Results:** Forearm TDC values did not differ between NO-DM and DM groups for any depth being  $27.5 \pm 3.2$  vs.  $28.8 \pm 3.8$  at 2.5mm;  $30.5 \pm 2.4$  vs.  $31.8 \pm 3.5$  at 1.5mm and  $32.4 \pm 3.9$  vs.  $34.5 \pm 4.5$  at 0.5mm. Contrastingly, TDC values were significantly greater ( $p < 0.05$ ) at the foot for the DM group at all depths being (NODM vs. DM)  $29.1 \pm 4.1$  vs.  $33.3 \pm 6.4$  at 2.5mm;  $28.9 \pm 3.5$  vs.  $32.5 \pm 5.9$  at 1.5mm and  $28.3 \pm 5.1$  vs.  $31.9 \pm 4.2$  at 0.5mm. Comparisons between genders showed no significant differences in TDC values between genders at any site or at any depth.

**Conclusions:** The greater TDC values found in persons with diabetes was unexpected and contrary to expectations. The finding is not consistent with the presence of decreased skin tissue water in DM as was originally hypothesized. It may be that this increased TDC (reflecting an increase in tissue water) may reflect preclinical edema not otherwise visualized. It is also interesting that this NO-DM vs. DM differential was significant only on the feet, an anatomical area that would be especially prone to edema formation. If true - the TDC method may be a useful screening tool for early detection of DM-related edema in certain patients. Further research into this emerging and potentially useful area is clearly indicated.