

## Skin-to-Fat Water in Diabetes Mellitus Assessed by Tissue Dielectric Constant (TDC): Apparent Independence with Respect to Depth, Anatomical Site and HbA1C

**Background and Purpose:** Worldwide, there are about 285 million people who have been diagnosed with Diabetes Mellitus (DM) and about 1/3 of them have skin changes. Prior research has indicated alterations in skin-to-fat tissue water especially prevalent in foot dorsum skin but specific mechanisms have not been clarified. Literature is consistent with the theory that hyperglycemia-induced non-enzymatic glycation of structural and regulatory proteins may play a role in the pathogenesis of diabetic complications. In this scenario, excess supply of glucose in the blood plasma leads to a non-enzymatic chemical reaction between the carbonyl group of glucose and the amino acid of proteins. This glycation of structural and regulatory proteins might play a role in the pathogenesis of diabetic skin complications. We hypothesized that in persons with DM the dermal collagen glycation displaces bound water and thereby decreases skin tissue water. If true then a measurable relationship between skin water and HbA1c should be present. The main purpose of this study was to test this hypothesis.

**Methods:** Skin-to-fat tissue water was determined by measurements of TDC at 300 MHz at the anterior forearm, lateral calf and foot dorsum in 34 persons with DM who were presenting for a routine clinic visit. TDC measurements were made by touching the target skin site with a sensor for about 10 seconds. The TDC value largely depends on the amount of free and bound water within the interrogation region. In this study 4 different sensors were used that allowed for measurements to 0.5, 1.5, 2.5 and 5.0 mm below the epidermis. In addition to TDC measurements, body composition parameters of each subject were determined using a bioimpedance scale on which the subject stood for about 15 seconds during the measurement. The parameters measured included percentages of total body water and fat and also limb segmental fat percentages.

**Results:** Comparisons among depths showed that TDC values monotonically decreased from the most shallow at 0.5 mm to the deepest at 5.0 mm ( $p < 0.001$ ). TDC values at each depth were significantly ( $p < 0.001$ ) different from each of the others. TDC values tended to be highest at the foot, middle at the leg and least at the forearm. However statistical significance of these differences depended on the measurement depth being highly significant at 5.0 mm ( $p < 0.001$ ) and not significant at 0.5 mm. However no significant negative correlation between TDC values and HbA1c was found at any depth or site.

**Conclusion:** The findings suggest that with respect to skin tissue water as assessed via TDC measurements, it is unlikely that HbA1c is of significant clinical importance.