Title: Face and Neck Skin Firmness and Water Content Assessed in Young Women
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Background: Prior research has suggested a link between skin’s mechanical properties and its water content. Such conclusions have generally been based on measurements of stratum corneum (SC) electrical capacitance as an indicator of SC water. Because SC measurements do not include the possible contribution of dermal or hypodermal water to the net skin mechanical properties this aspect of the role of skin water has not been investigated. An understanding and characterization of any such relationships might pave the way for detecting early skin changes that accompany pathological changes or those related to normal age-related changes. We hypothesized that skin hydration, as measured by tissue dielectric constant values (TDC) in upper dermis and deeper, will in fact directly correlate with measures of skin firmness.

Objective: Our goal was to test this hypothesis and to additionally provide reference skin water-skin firmness data for subsequent assessments of potential age-related changes.

Methods: All data is expressed as mean ± SD. Skin water was assessed by tissue dielectric constant measurements (TDC) at 300 MHz to skin depths of 0.5 mm and 2.0 mm on four face sites and two forearm sites of 28 healthy subjects (25.1 ± 1.7 years). TDC values are dimensionless since they are ratios of tissue to vacuum permittivity. For reference, water has a value of 76 at 32°C. Skin firmness at these sites was determined by measuring the FORCE needed to indent skin 1.3 mm with force in mNewtons (mN). Regression analysis was used to test the hypothesized inverse relationship between skin firmness and TDC values which are indices of local skin tissue water. Skin firmness was also measured on two neck sites and compared to values at the other sites. Percentages of total body water (TBW) and body fat (TBF) were measured by bioimpedance at 50 KHz and were 52.3 ± 4.8% and 29.2 ± 6.9% respectively. BMI was 23.2 ± 3.9 Kg/m². All subjects signed an IRB approved consent form.

Results: Among face sites, FORCE varied between 25.6 ± 6.8 and 43.3 ± 17.2 mN (p<0.001) with an overall average of 33.6 ± 7.2 mN. Average values of FORCE at neck and forearm were 28.2 ± 9.1 and 58.4 ± 18.9 mN with arm values significantly greater than face or neck (p<0.001). TDC averages varied by face site with an overall average among the four face sites of 35.4 ± 3.8 at 0.5 mm and 37.2±4.1 at 2.0 mm depths. Forearm average TDC values were significantly less (p<0.001) being 31.4±4.1 and 27.1±4.3 for 0.5 and 2.0 mm depths respectively. Regression analysis showed an inverse correlation between FORCE and TDC on forearm (r = -0.624, p<0.001) but no significant correlation on face. Contrastingly, TDC values on forearm and face correlated with TBW and inversely with TBF (p<0.05).

Conclusion: Results suggest that face and forearm skin water-skin firmness relationships are quite different with no demonstrable relationship for face skin and a negative correlation for forearm. A possible explanation for this differential may lie with the significantly greater forearm skin firmness yet similar TDC values. So, the results are only partially consistent with the initial hypothesis which indicates additional anatomical sites need be studied to determine if a more general relationship exists. The additional findings that face and forearm TDC values directly correlate with total body water suggests that skin hydration might be positively affected by maintaining adequate water intake. This however would need to be tested prospectively. Finally, the skin firmness data for face, neck and forearm for this young female group should provide reference data for subsequent comparisons of possible age affects.