

HAND VOLUME ESTIMATES BASED ON A GEOMETRIC ALGORITHM IN COMPARISON TO WATER DISPLACEMENT

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ABSTRACT

Assessing changes in upper extremity limb volume during lymphedema therapy is important for determining treatment efficacy and documenting outcomes. Although arm volumes may be determined by tape measure, the suitability of circumference measurements to estimate hand volumes is questionable because of the deviation in circularity of hand shape. Our aim was to develop an alternative measurement procedure and algorithm for routine use to estimate hand volumes. A caliper was used to measure hand width and depth in 33 subjects (66 hands) and volumes (V_E) were calculated using an elliptical frustum model. Using regression analysis and limits of agreement (LOA), V_E was compared to volumes determined by water displacement (V_w), to volumes calculated from tape-measure determined circumferences (V_C), and to a trapezoidal model (V_T).

V_w and V_E (mean \pm SD) were similar (363 \pm 98 vs. 362 \pm 100 ml) and highly correlated; $V_E = 1.01V_w - 3.1$ ml, $r=0.986$, $p<0.001$, with LOA of ± 33.5 ml and ± 9.9 %. In contrast, V_C (480 \pm 138 ml) and V_T (432 \pm 122 ml) significantly overestimated volume ($p<0.0001$). These results indicate that the elliptical algorithm can be a useful alternative to water displacement when hand volumes are needed and the water displacement method is contraindicated, impractical to implement, too time consuming or not available.