

Hand Measurement Procedure

The following pages illustrate measurement procedures that may be used to assess hand volumes. One is based on measurements of hand width and depth at standard sites and the other using circumference measurements. In either case LVP4.0 automatically calculates volumes with the option for these volumes to be included in upper extremity volume determination. The measurement data is simply entered into the appropriate cells in the HANDC page of the LVP4.0 software.

Research has shown that the width-depth method is more accurate than the circumference method. Some of the supporting evidence is included.

The algorithm used by LVP4.0 to determine hand volume and its change with therapy has been substantiated by extensive research in which hand volumes were determined directly using the water displacement method, which is the accepted gold standard.

Volume estimates based on the width-depth algorithm deviate on average from those obtained with water displacement by less than 5%, which is adequate for most clinical purposes.

The method illustrated is that used in a research study but other methods of obtaining the metric data may be equally useful. Although inclusion of hand volume requires some additional time, there are many clinical conditions in which such additional effort is well warranted.

You the clinician/therapist are the best judge of its utility.

If there are any questions please contact us at support@limbvolumes.org

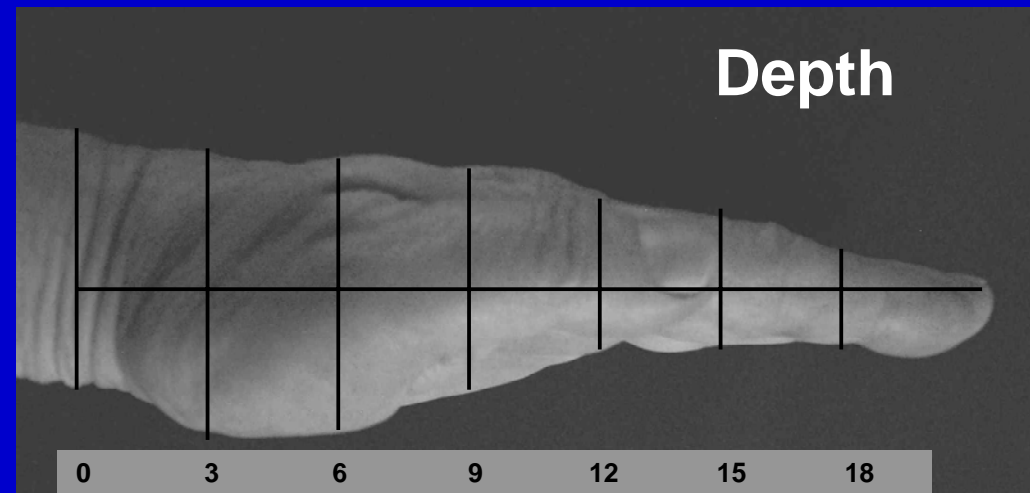
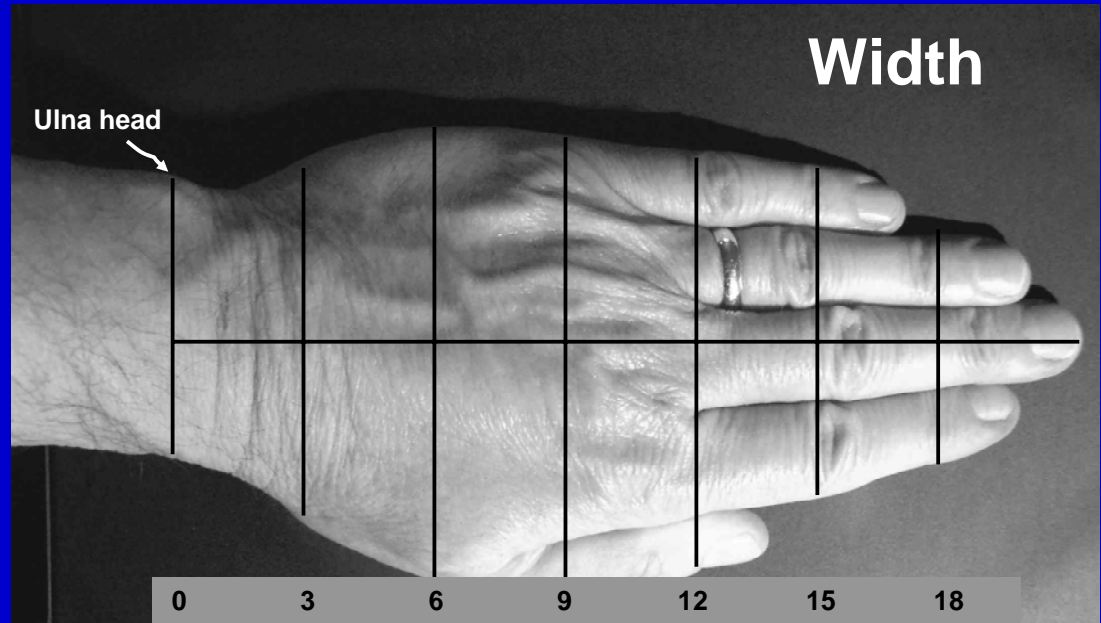
Measurement and Calculation Summary

Width and Depth Measurements

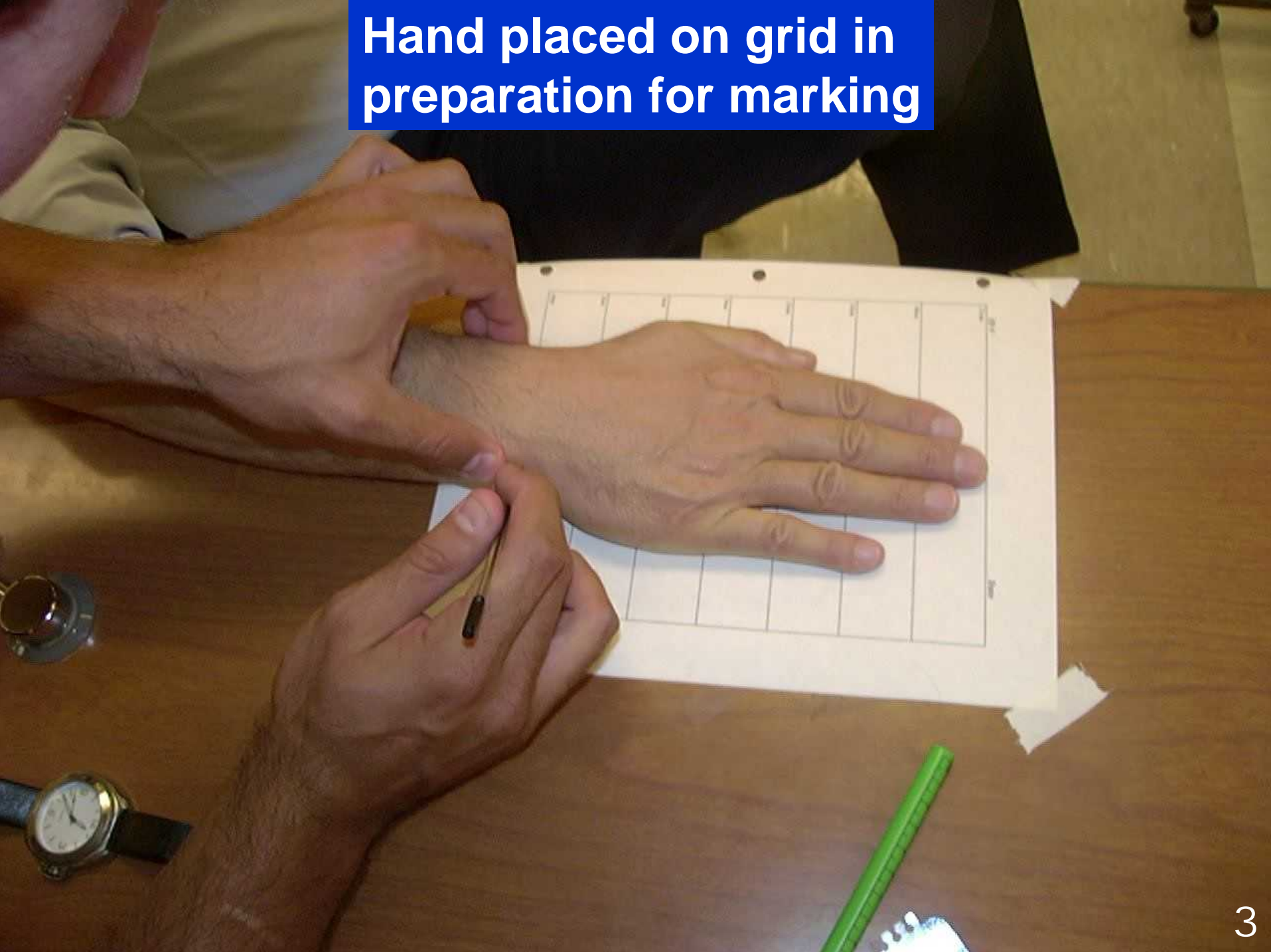
Measurements are made using a digital caliper every 3 cm starting at the wrist. (styloid process as reference)
Last segment, includes the finger tip may be less than 3 cm

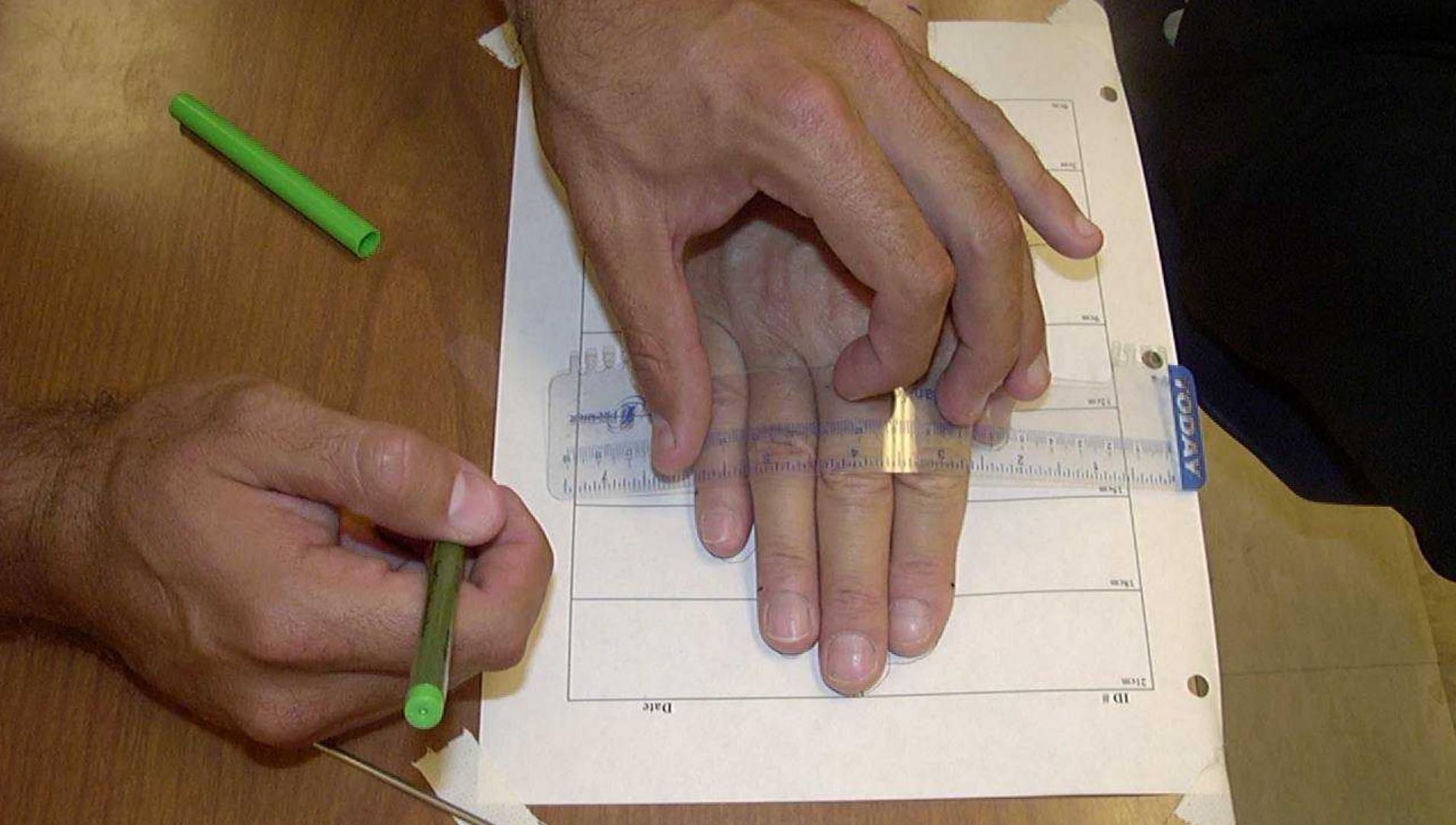
Calculations

Volume of each segment based on a calculation algorithm that treats each segment of length as a frustum with an elliptical cross sectional area.
Total hand volume is then the sum of all segment volumes.
These are done automatically using LVP4.0 software.



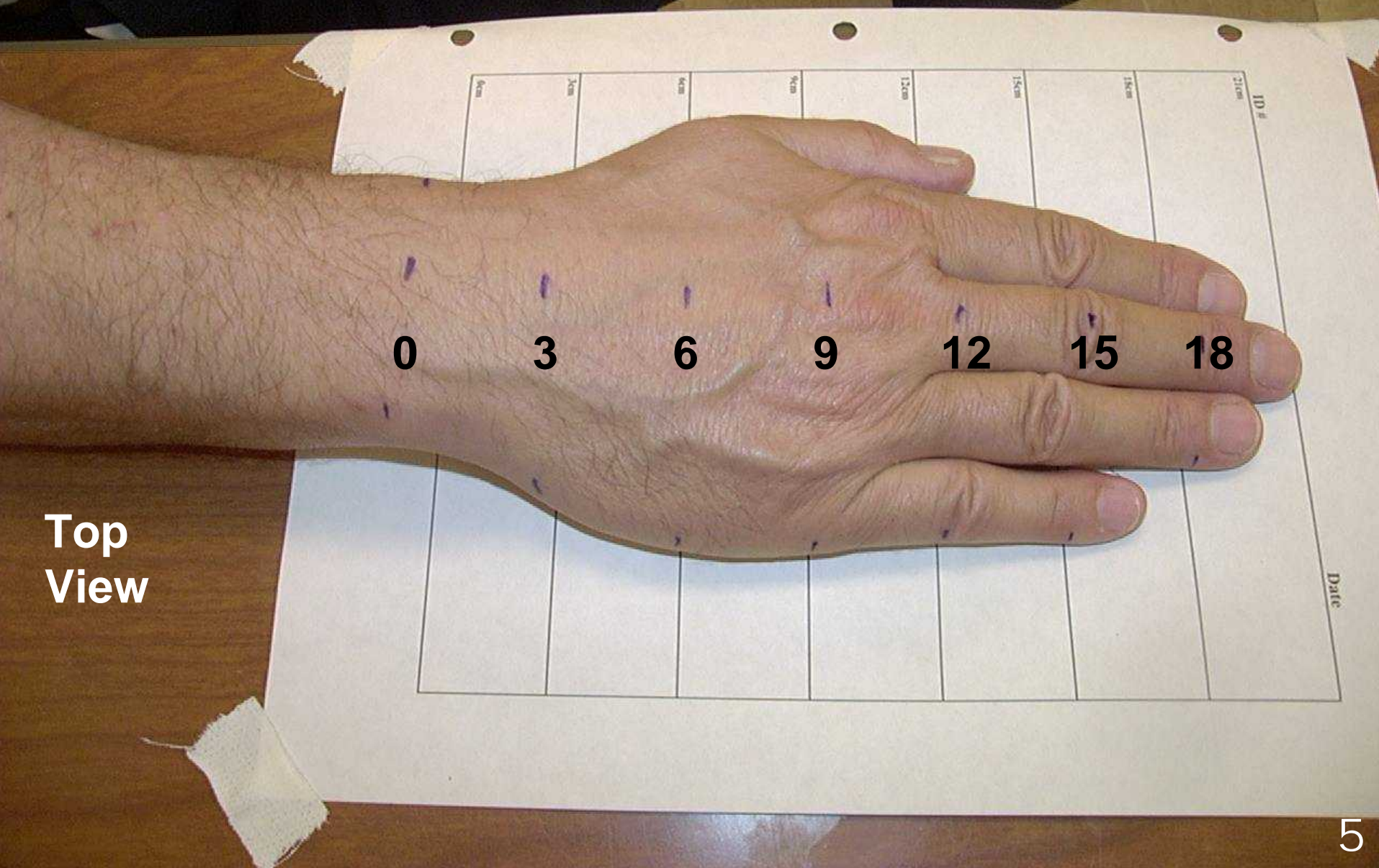
Hand placed on grid in preparation for marking





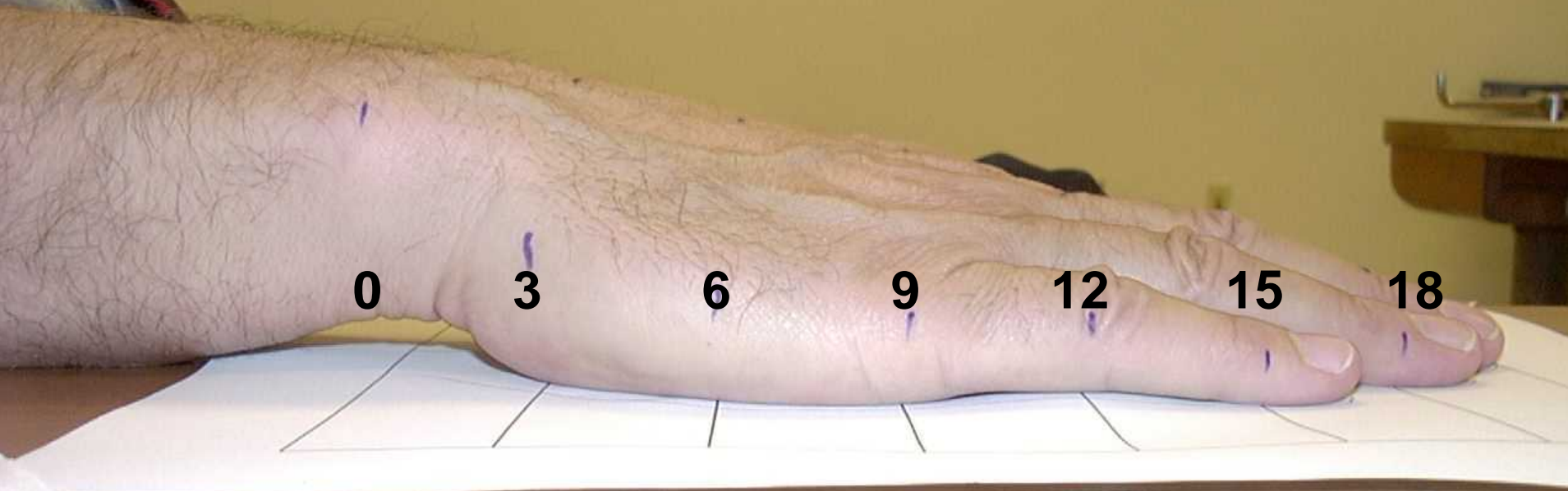
Hand placed on grid for marking at 3 cm intervals using a surgical marking pen and flexible rule

Hand on grid with marks at 3 cm intervals with zero point at wrist



Top View

Hand on grid with marks at 3 cm intervals with zero point at wrist



Side View

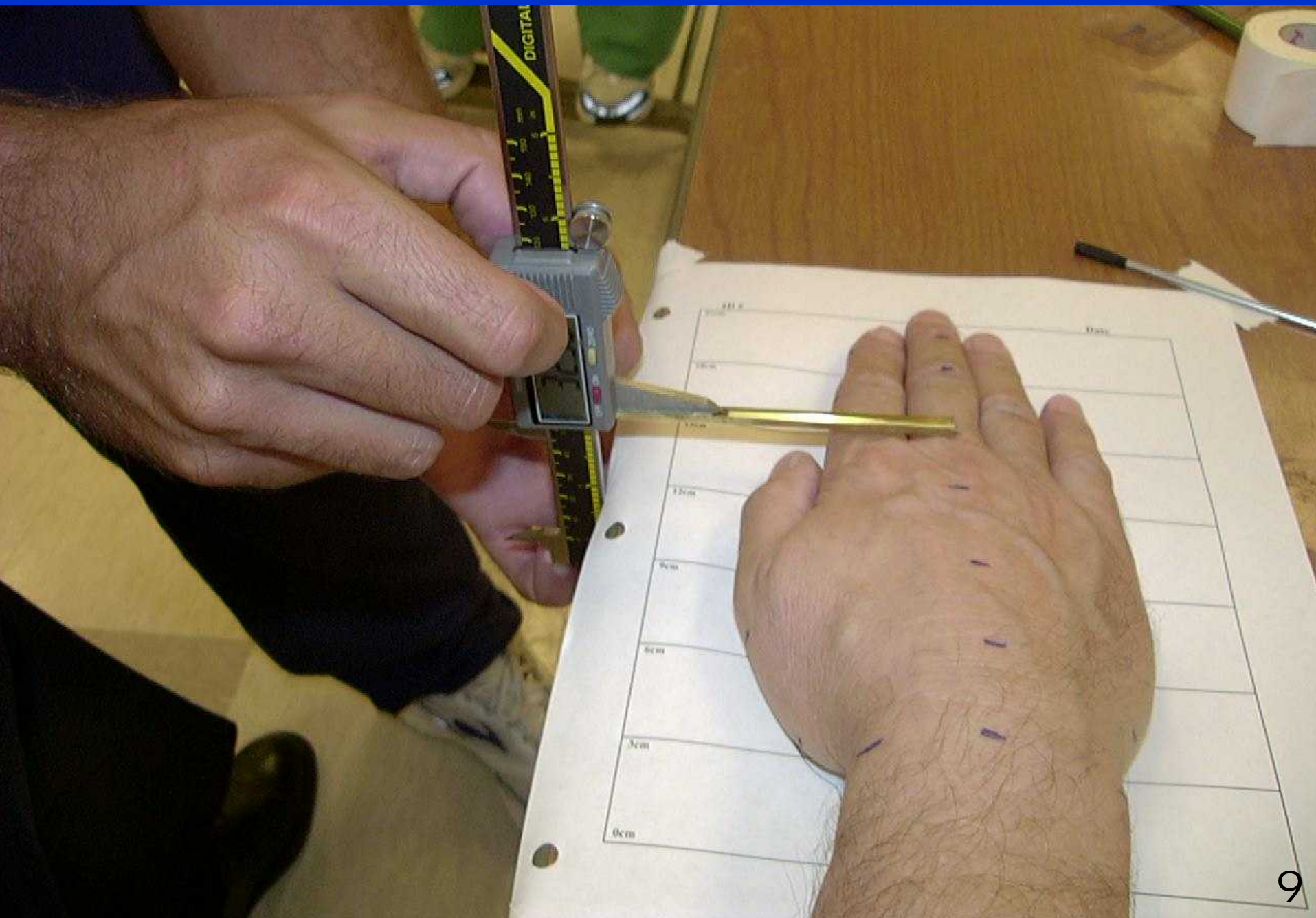
**Hand ready for depth measurements at each site.
Arm rests comfortably on vertically adjustable table**



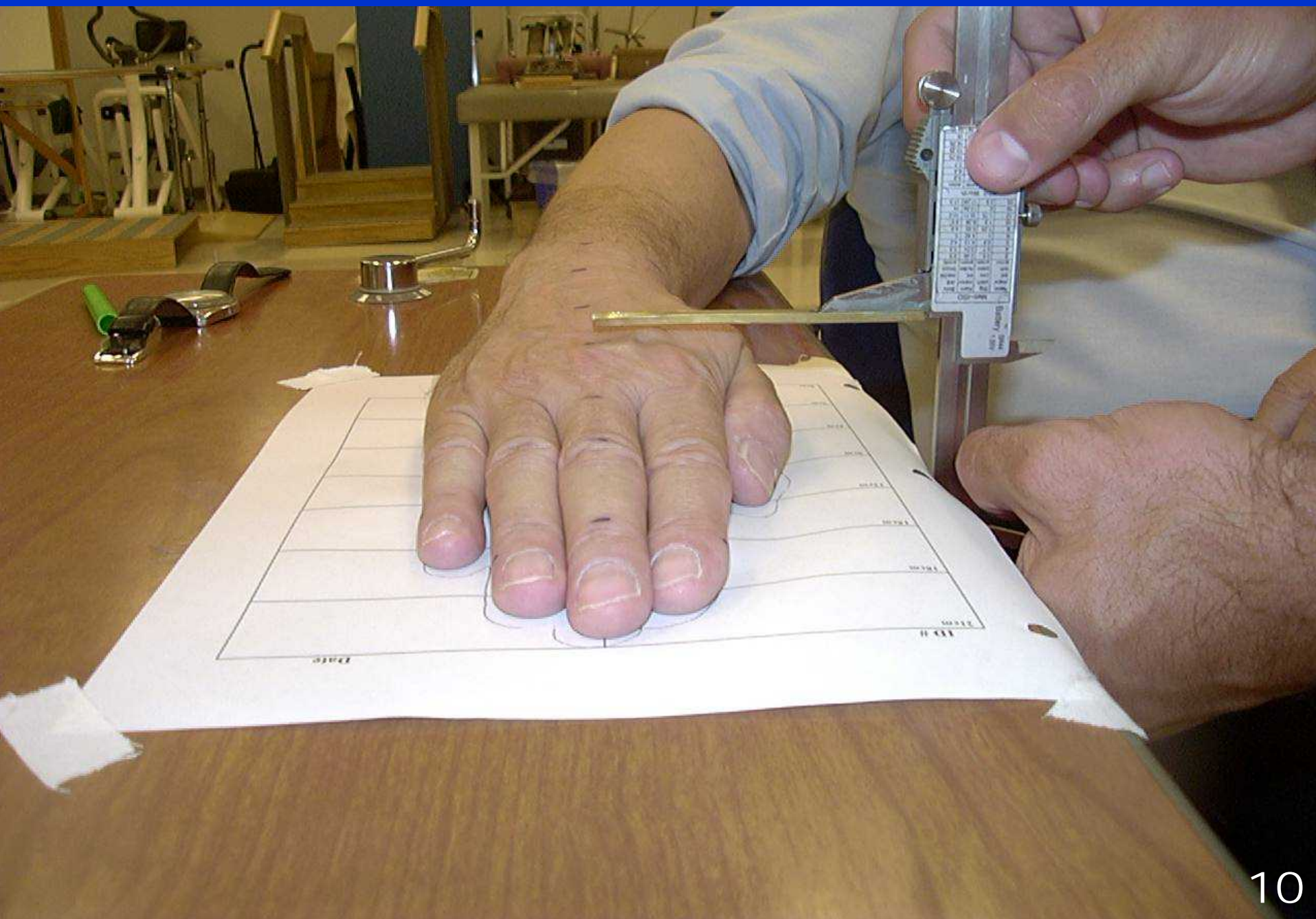
Zeroing offset of digital caliper used for hand depth



Measuring depth with digital caliper in millimeters



Measuring depth with digital caliper in millimeters



Measuring circumference with Gulick tape measure

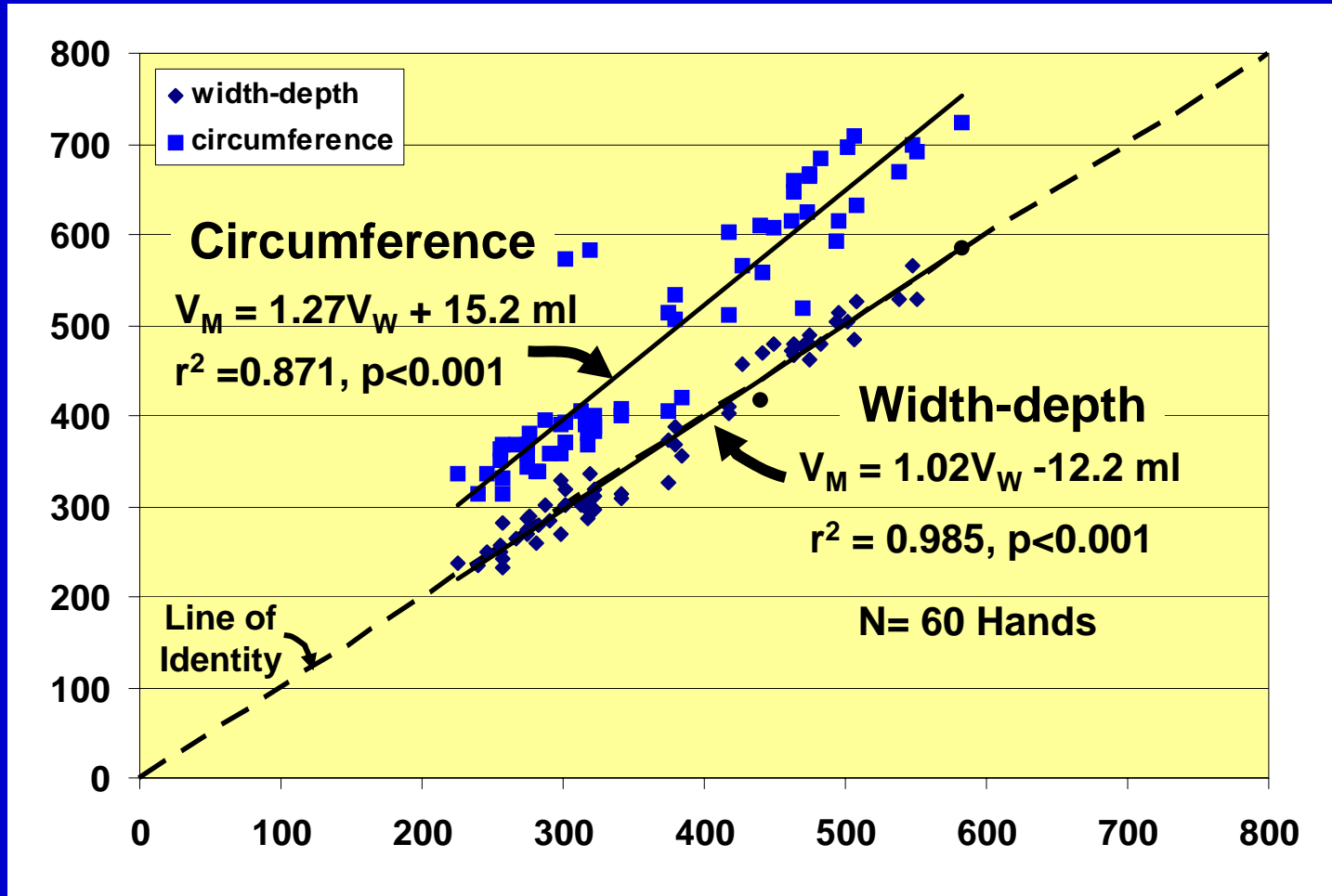


Measuring circumference with Gulick tape measure



LVP4.0 Algorithm vs. Water Displacement

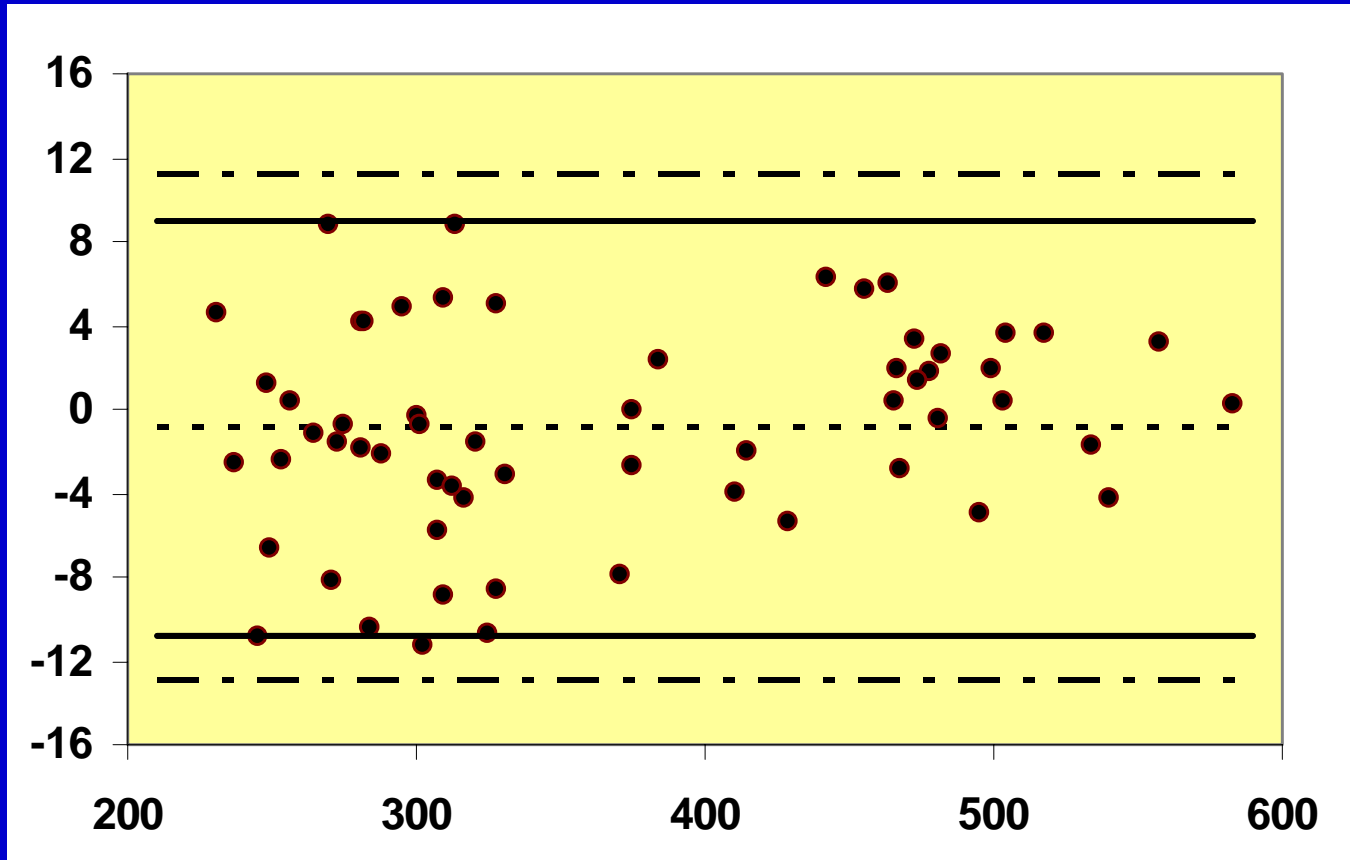
Volume by Algorithm
(V_M , ml)



Volume by Water Displacement (V_W , ml)

Limits of Agreement (%)

Percent Difference
 $(V_W - V_M) / V_W \%$



Mean Volume $(V_W + V_M)/2$ in ml

	Difference	LOA	95% CI
$(V_W - V_M) / V_W \%$	$-0.9 \pm 4.9\%$	$\pm 9.8\%$	+11.2 to -12.9