

# 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 LVP 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 LVP 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 LVP 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.

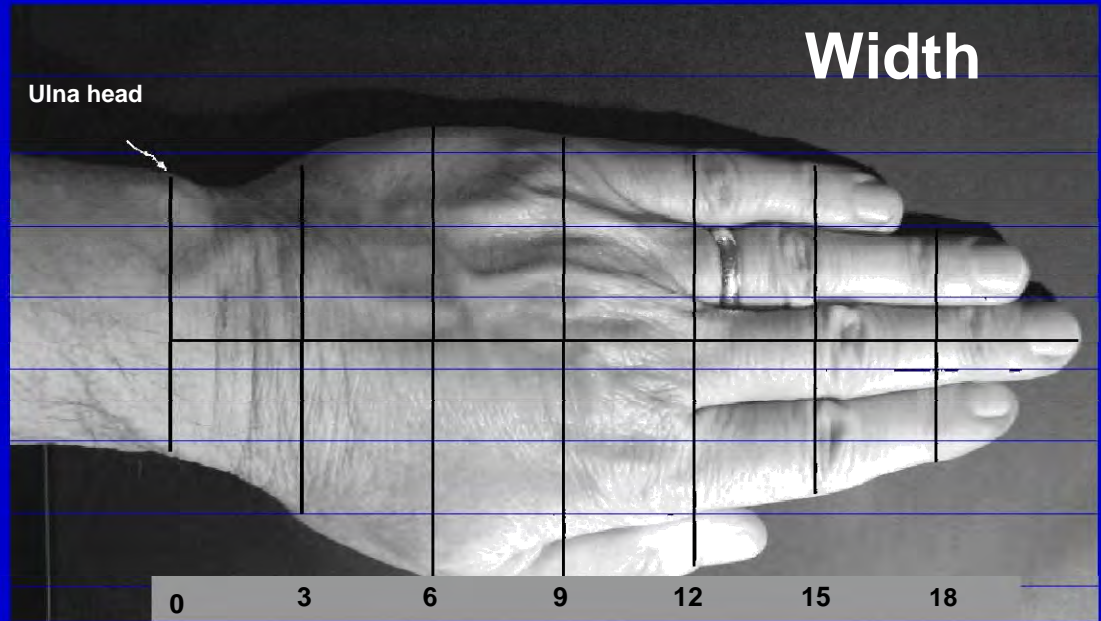
The method illustrated is that used in a research study but other methods of obtaining the metric data may be are equally useful. Although inclusion of hand volume requires some additional time, there are many clinical conditions in which such additional effort is well warranted. You the clinician/therapist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

If there are any questions please contact us at [support@limbvolumes.org](mailto:support@limbvolumes.org)

# Measurement and Calculation Summary

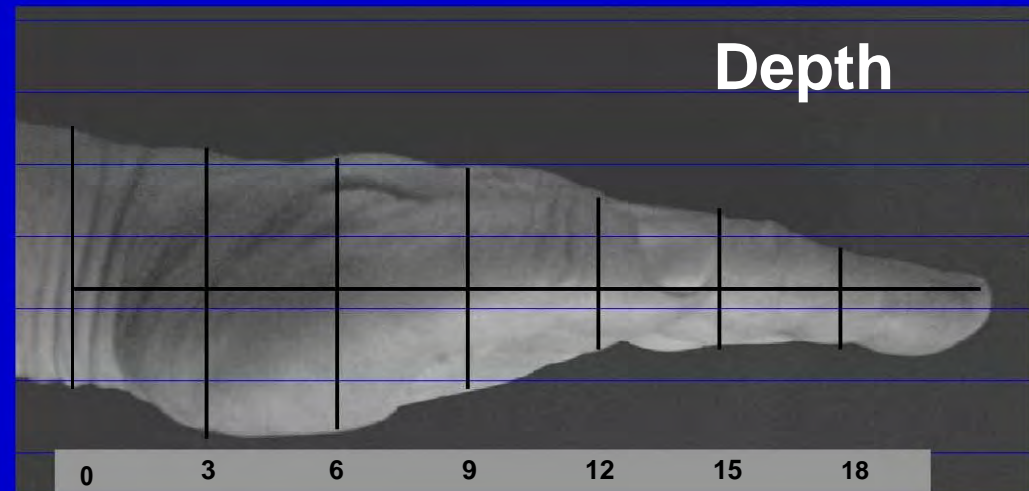
## Width and Depth Measurements

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

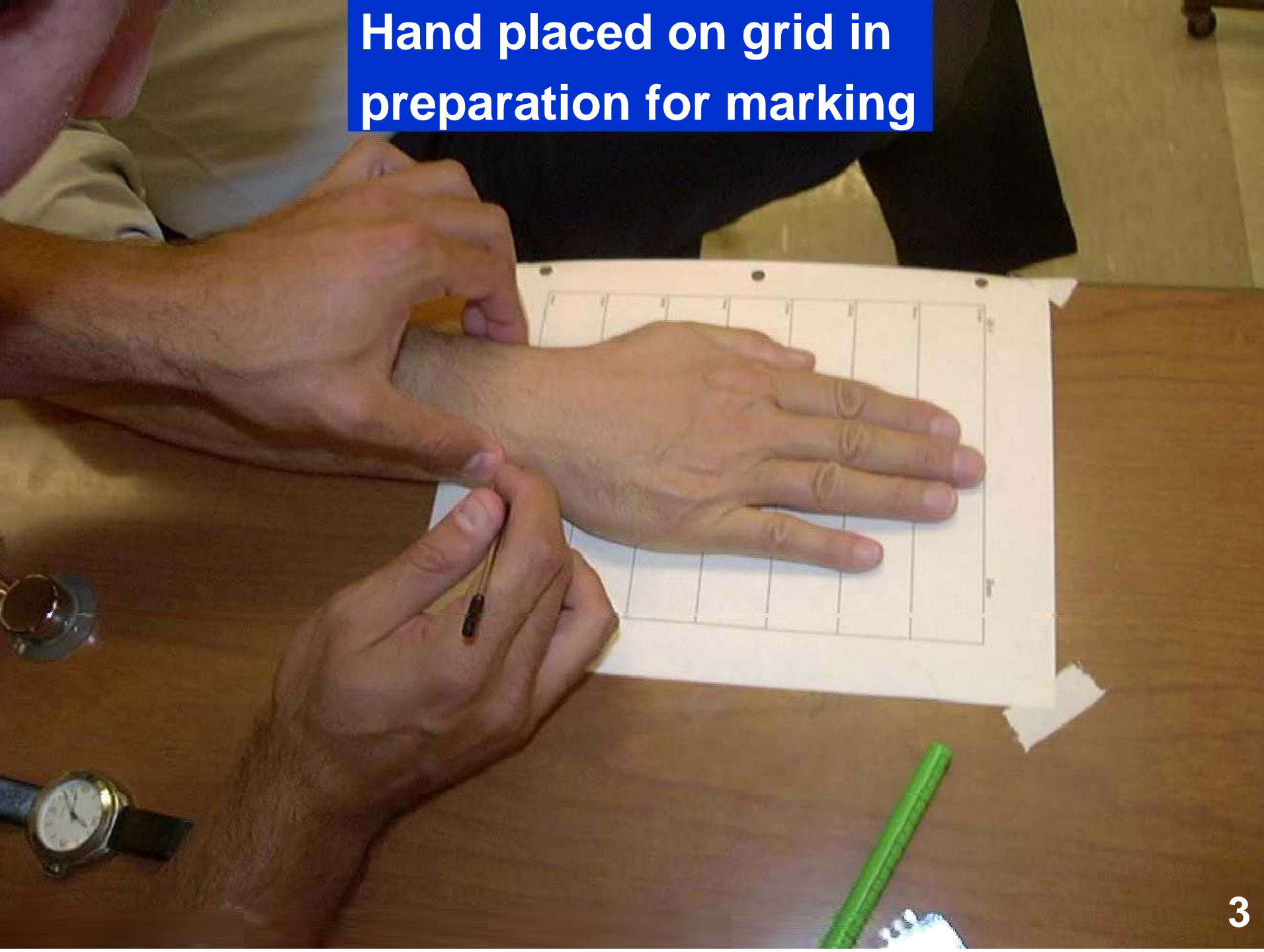


## Calculations

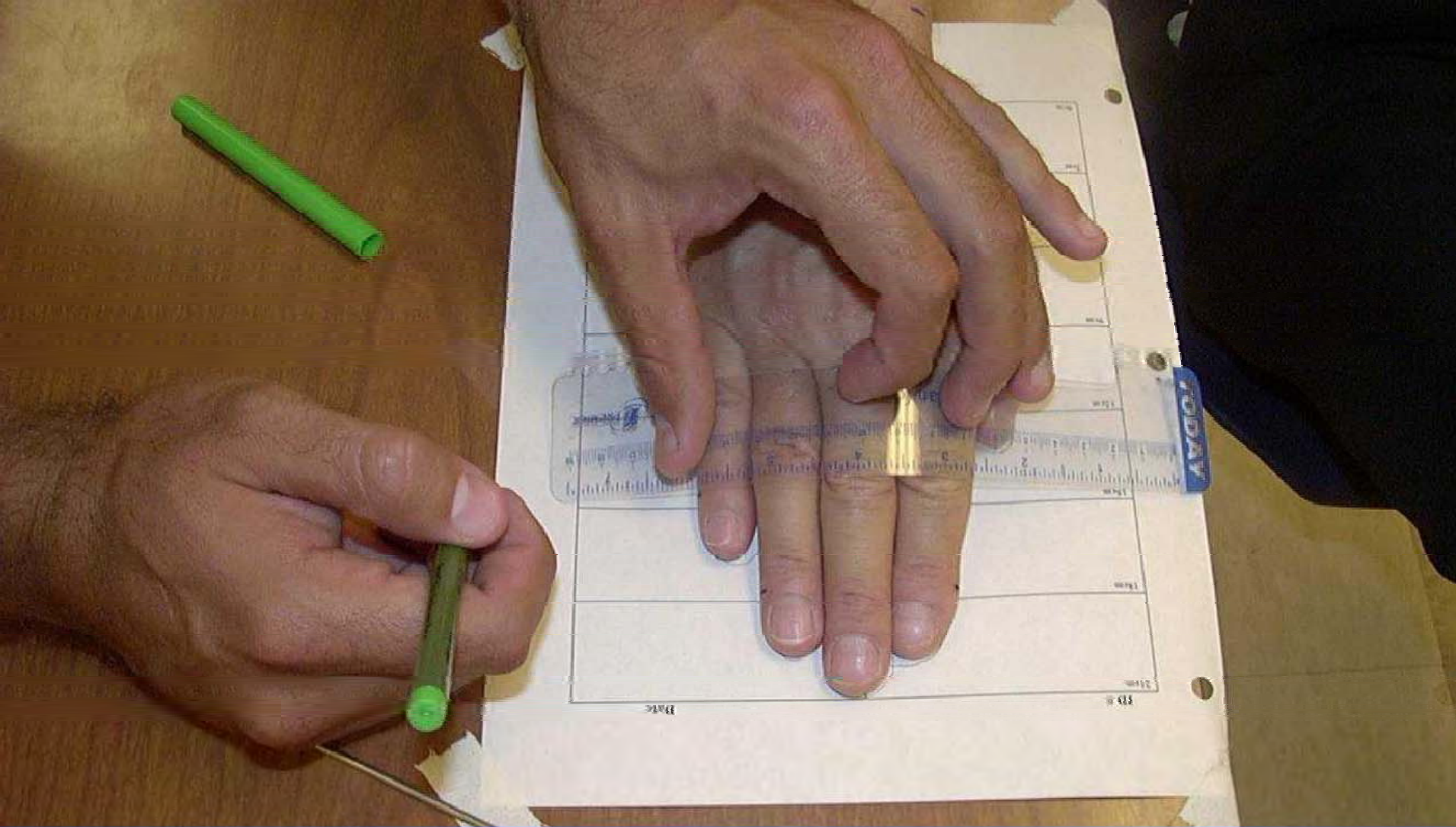
Volume of each segment based on a calculation algorithm that treats each segment of length as a frustum with an elliptical cross sectional area.  
Total hand volume is then the sum of all segment volumes.  
These are done automatically using LVP software.



**Hand placed on grid in  
preparation for marking**

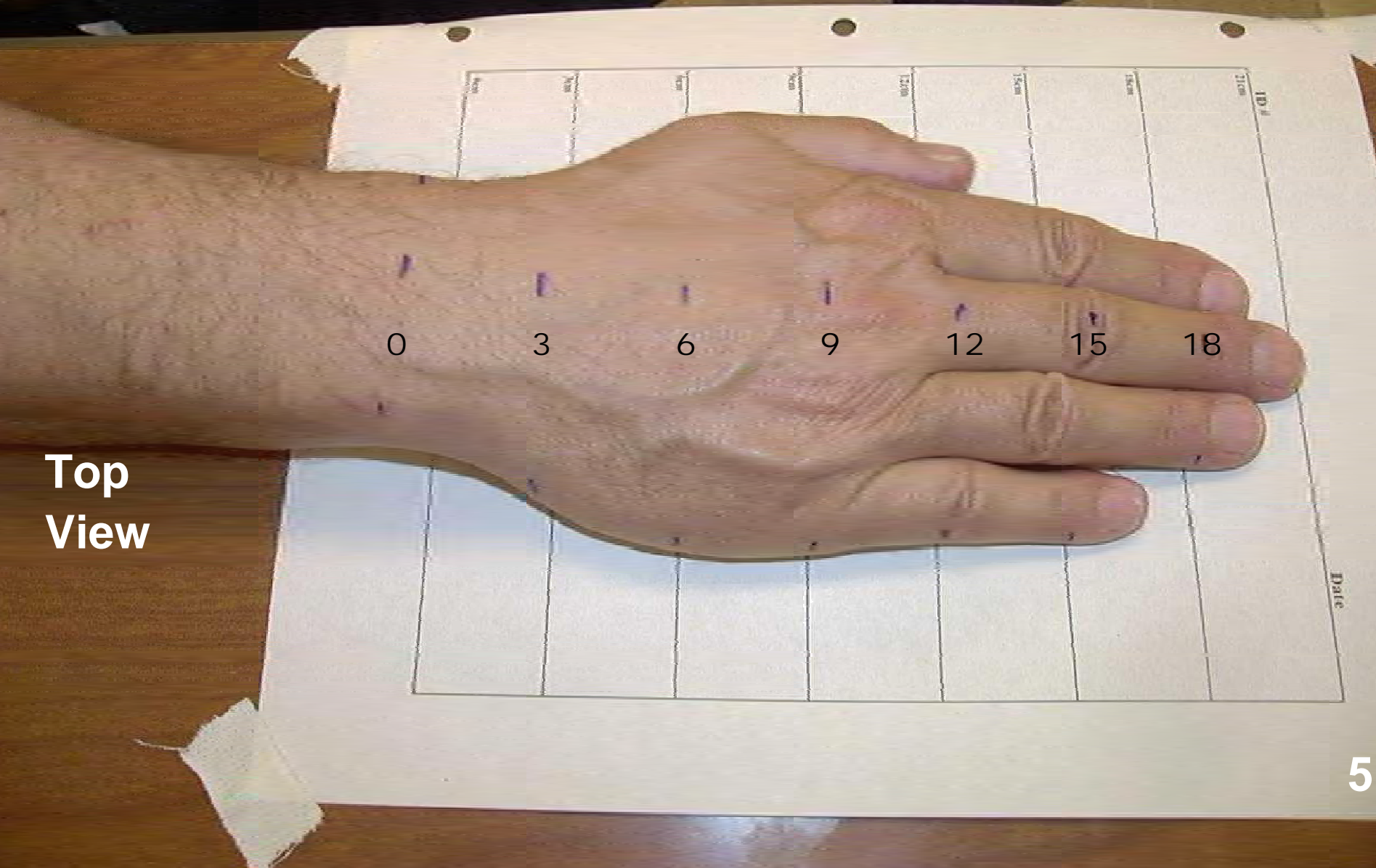






**Hand placed on grid for marking at 3 cm intervals  
using a surgical marking pen and flexible rule**

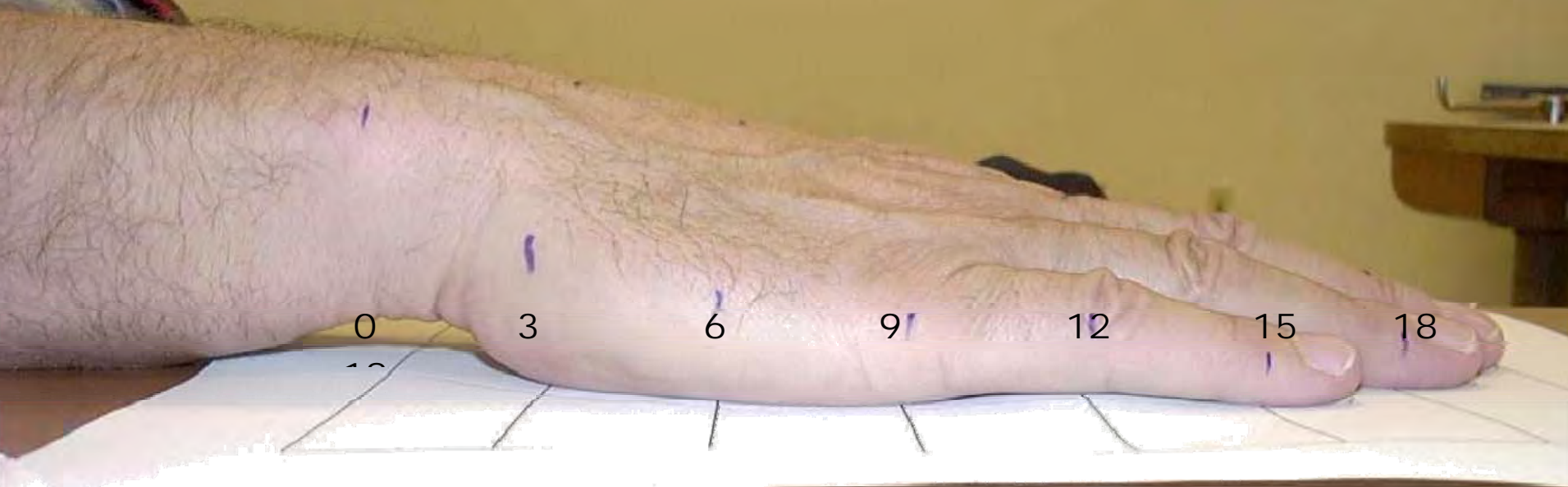
Hand on grid with marks at 3 cm intervals with zero point at wrist



Top  
View



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



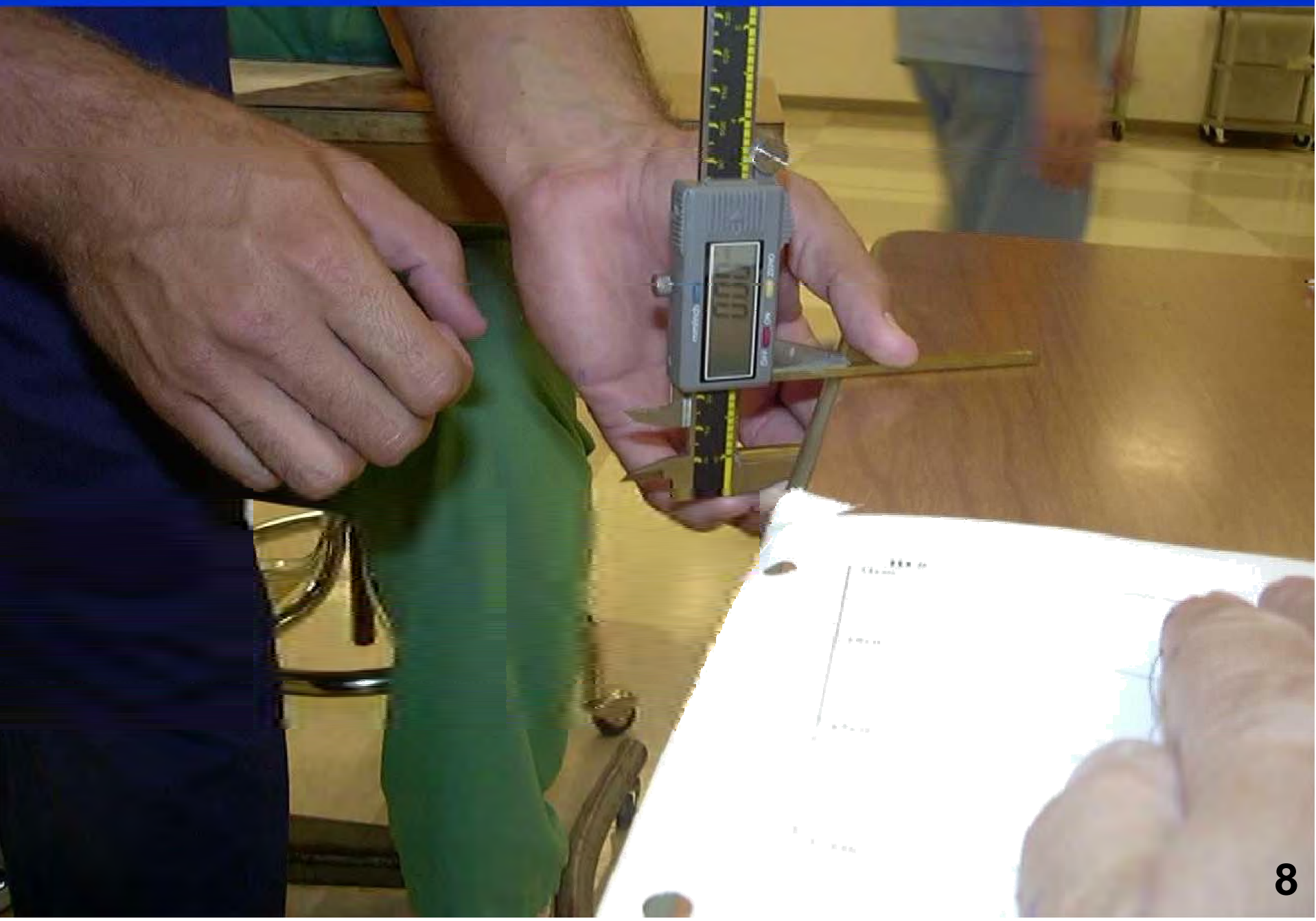
**Side View**

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



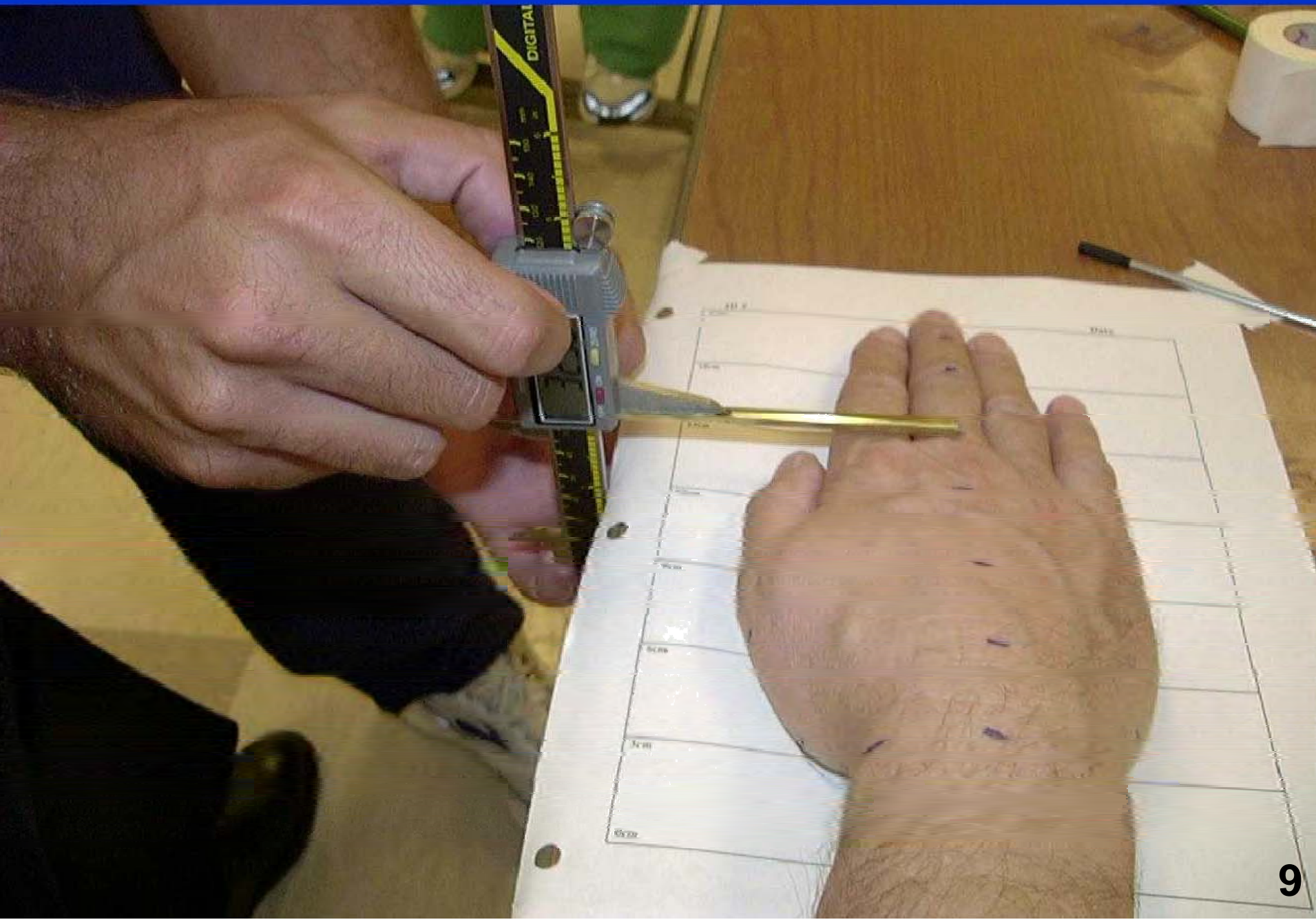


# Zeroing offset of digital caliper used for hand depth

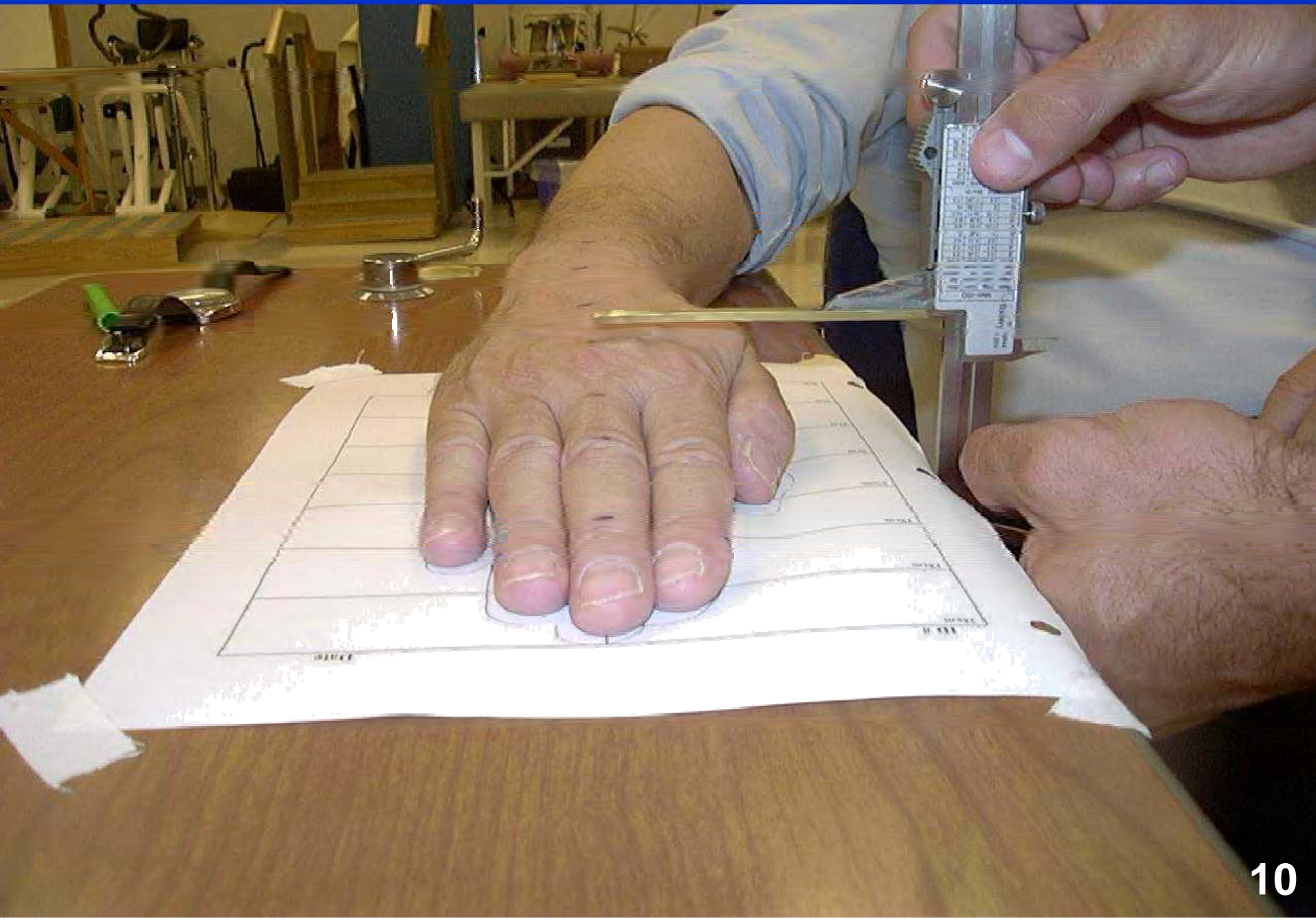




# Measuring depth with digital caliper in millimeters

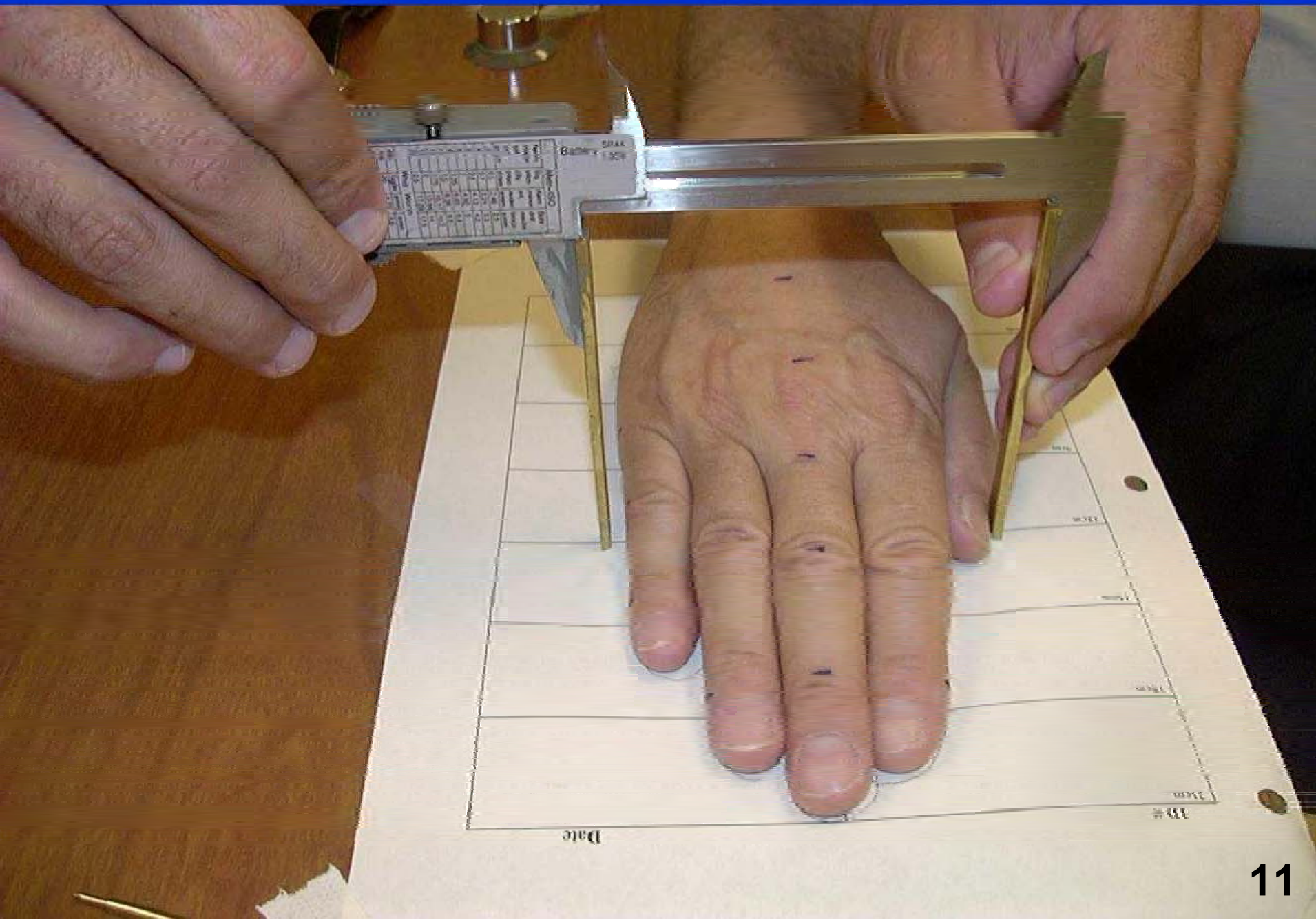


# Measuring depth with digital caliper in millimeters



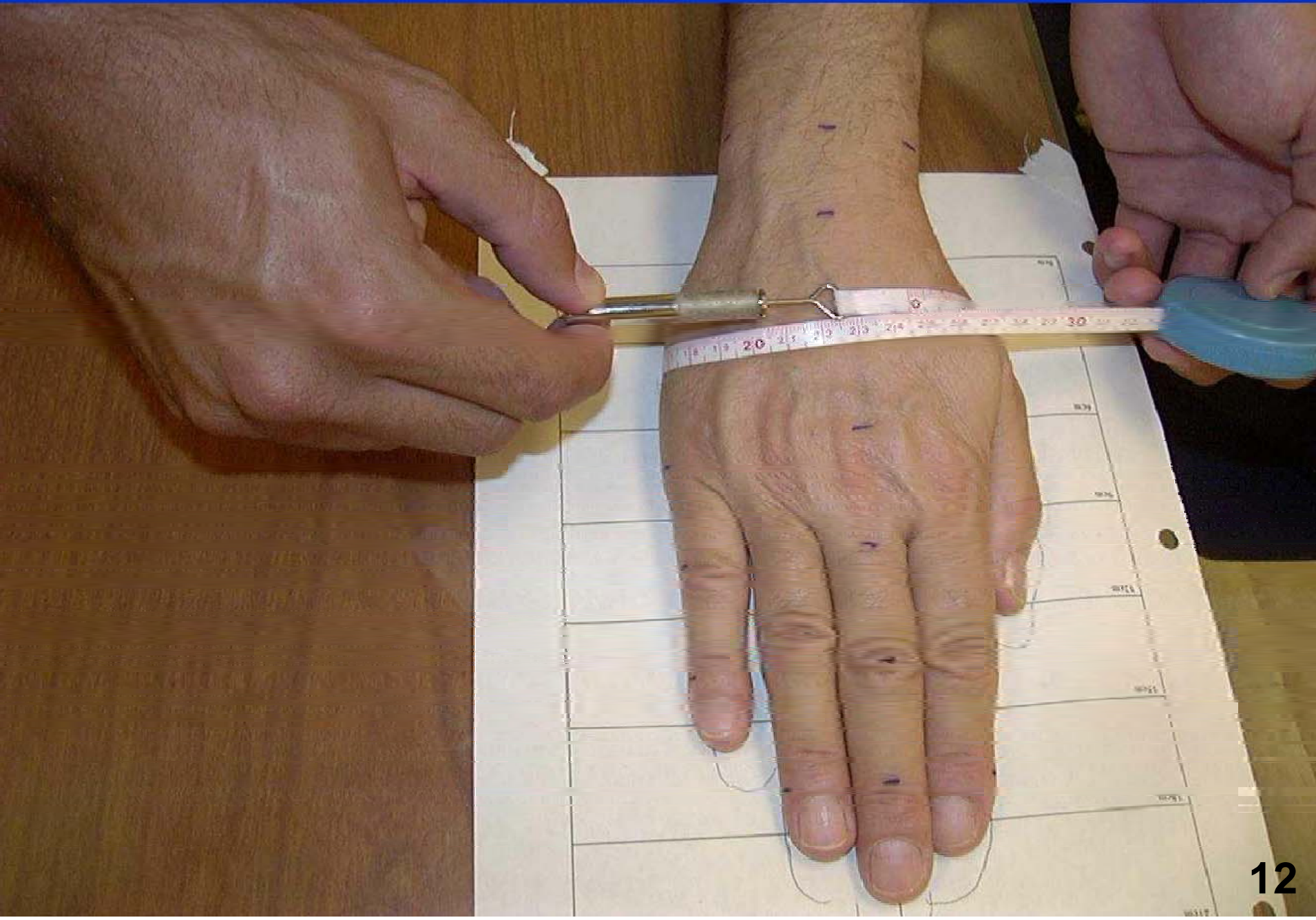


# Measuring width with digital caliper in millimeters

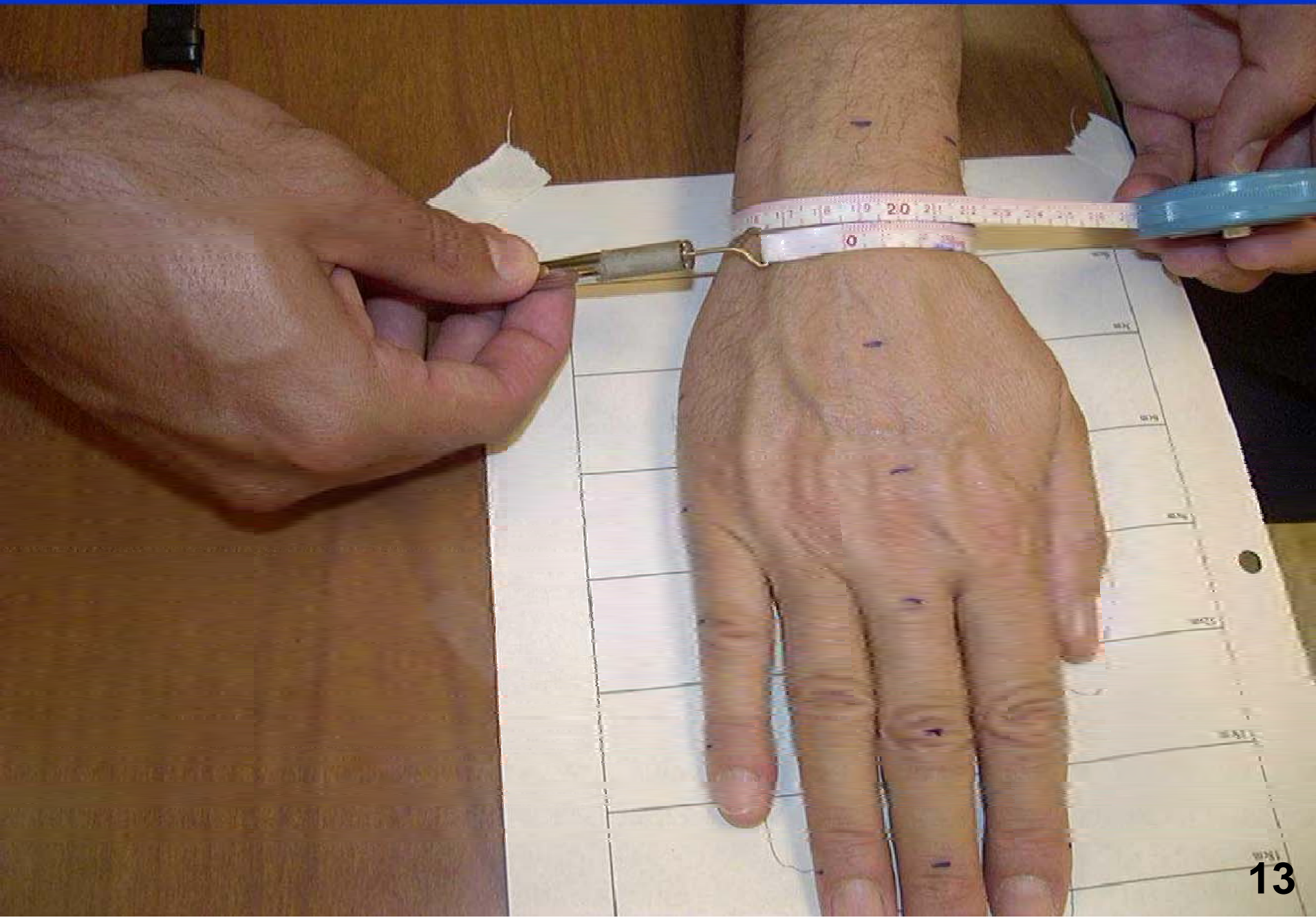




# Measuring circumference with Gulick tape measure



# Measuring circumference with Gulick tape measure

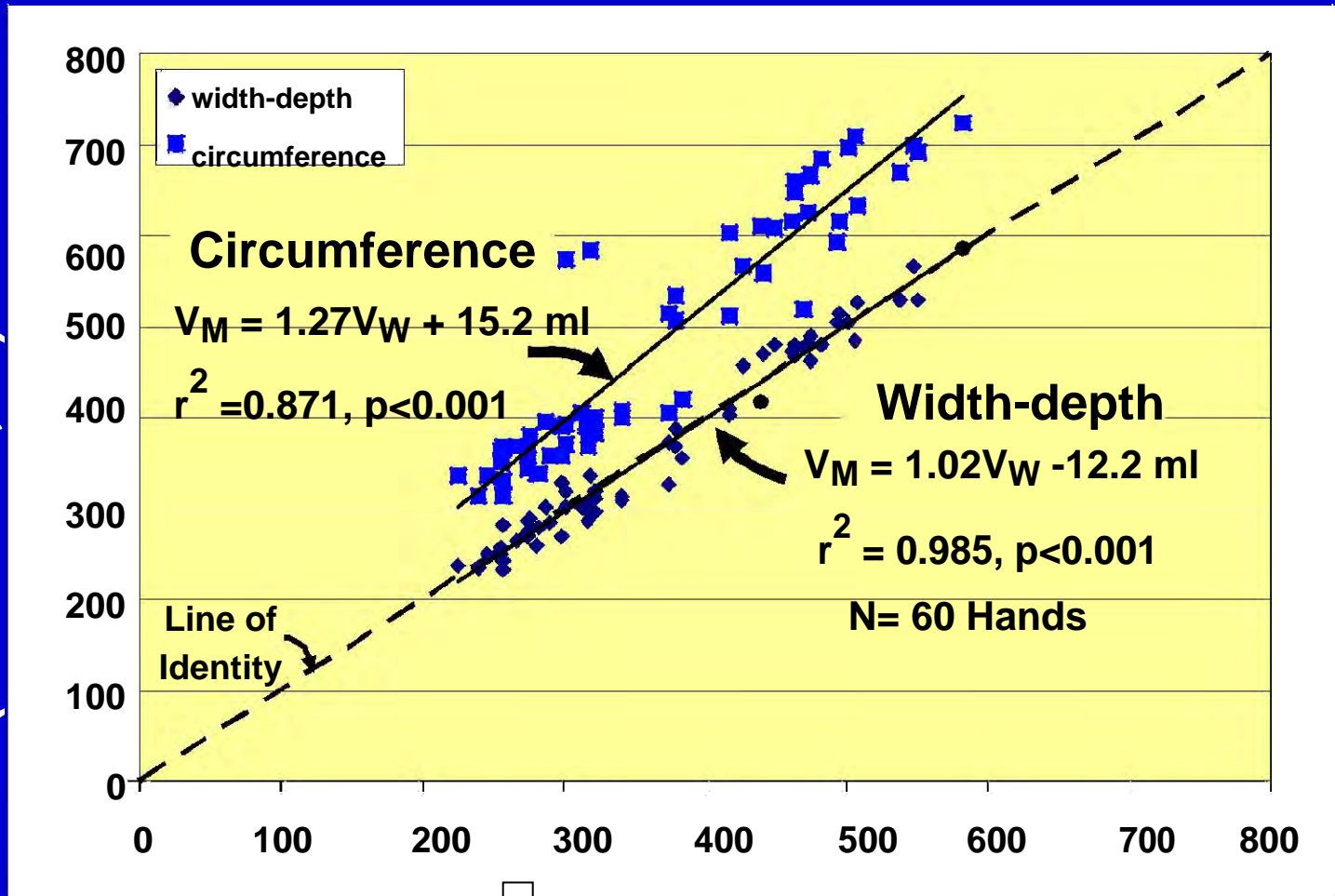




# LVP4.0 Algorithm vs. Water Displacement

Volume by Algorithm

(V  
ml)

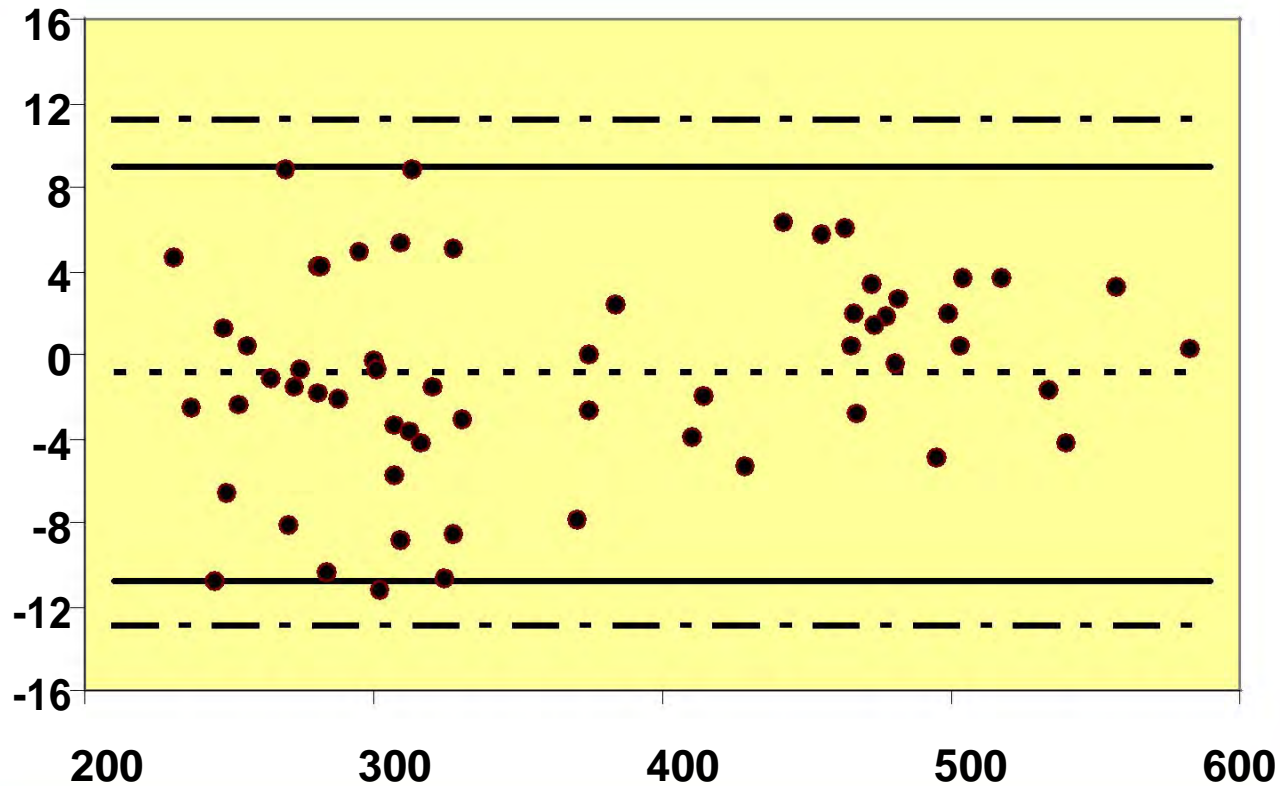


Volume by Water Displacement ( $V_W$ , ml)



# 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 |