TEST-RETEST RELIABILITY OF A 3-D PRINTED ULTRASOUND GUIDE

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BACKGROUND

- Brightness-mode (B-mode) ultrasound is a popular non-invasive imaging modality used to assess skeletal muscle size (ACSA)[1-2]
- Typically, traditional B-mode images are acquired with a trained and experienced investigator
  - Without an experienced investigator, it is often difficult to obtain high quality and repeatable images of skeletal muscle[3]
- A recent custom-built ultrasound probe guide has been developed, which may reduce measurement error and increase reliability of ultrasound imaging

PURPOSE: The purpose of this study was to compare the test-retest reliability between a custom-built ultrasound probe guide and manual ultrasound imaging of the rectus femoris

Figure 1. *The 3D printed probe guide used to acquire ACSA scans. The cradle is used to control the pitch and yaw of the probe and is then placed on the customized tracks during cross sectional plane ultrasound scans*

PRACTICAL APPLICATIONS

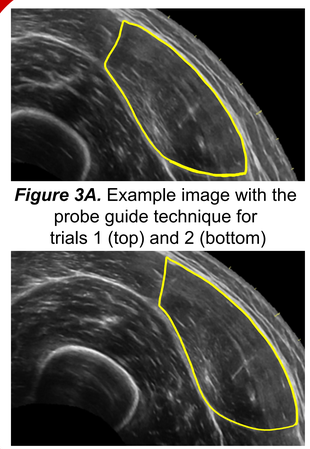

Figure 3A. Example image with the probe guide technique for trials 1 (top) and 2 (bottom)

The custom-built probe guide may **increase the reliability** of ultrasound imaging and allow for **increased precision of measurement** for practitioners and researchers who aim to have the most reliable techniques

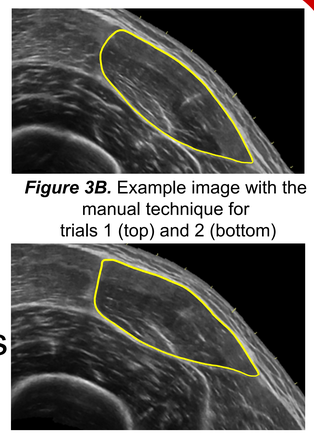

Figure 3B. Example image with the manual technique for trials 1 (top) and 2 (bottom)

METHODS

Ultrasound Assessment

- 40 participants
  - Age: 21 ± 3 yrs; BMI: 24.5 ± 4.2 kg/m^2
- Completed one visit to the laboratory for B-mode ultrasound imaging of the rectus femoris (RF)
- Four data collection trials (2 probe guide, 2 manual) were performed each separated by 10 minutes
- ACSA scans were taken along the length of the RF separated by 1.5 cm

Statistical Analysis

- Test-retest reliability statistics (i.e., interclass correlation coefficient [$ICC_{2,1}$], standard error of measure [SEM], and minimal difference [MD] needed to be considered real) were quantified for both manual and probe guided images

Ultrasound Analysis

- Images were manually analyzed in an open-source imaging software by a single investigator (ImageJ, NIH, Bethesda, MD)
- Images were carefully traced with the polygon tool, selecting the surrounding muscle tissue of the RF
- Muscle volume was estimated using the Cavalieri technique with the ACSA scans[4]
- $MV = \sum_n e_i \times ACSA$

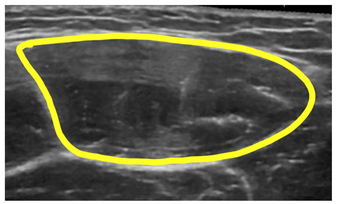

Figure 2. Example ACSA scan of the rectus femoris highlighted in yellow.

RESULTS

- The probe guided method indicated good reliability ($ICC_{2,1}$ = 0.84)
- The manual technique demonstrated moderate reliability ($ICC_{2,1}$ = 0.74)

Rectus Femoris Muscle Volume

	$ICC_{2,1}$	SEM (%)	MD (cm^2)
Probe Guide	0.84	4.92	9.63
Manual	0.74	5.83	11.44

Table 1. *Test-retest reliability statistics for the probe guided and manual technique. Test-retest reliability statistics were calculated for trials 1 and 2 (i.e., interclass correlation coefficient [ICC] model 2,1, standard error of measure [SEM], and minimal difference [MD] values needed to be considered real)*

CONCLUSION

- The findings suggest that the ultrasound probe guide used when quantifying muscle volume is more reliable and may have less error between repeated scans compared to the manual technique
- Future studies should assess the utility of this approach with other muscles and with technicians of varying experience levels

References

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4. Wohlgemuth KJ, et al., Reliability and accuracy of ultrasound image analyses completed manually versus an automated tool. PeerJ 10: e13609, 2022.