NEUROMUSCULAR & OCCUPATIONAL PERFORMANCE LAB

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TEST-RETEST RELIABILITY OF A 3-D PRINTED GUIDE FOR VASTUS LATERALIS MUSCLE VOLUME

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BACKGROUND

- Brightness-mode (B-mode) ultrasound is a portable, quick, and cost-effective way for clinicians and researchers to track muscle morphology in real-time [1-2]
- It is paramount that B-mode images are acquired with a trained and experienced investigator[1]
  - Without an experienced investigator, it is often difficult to obtain high quality and repeatable images of skeletal muscle[3-4]
  - A 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 (PGT) and traditional (TRAD) ultrasound imaging for the vastus lateralis
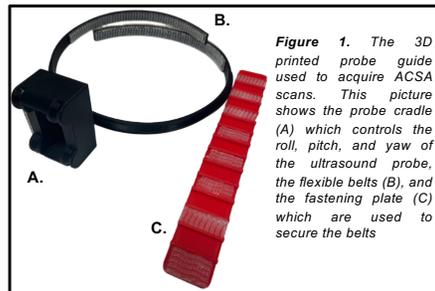

Figure 1. The 3D printed probe guide used to acquire ACSA scans. This picture shows the probe cradle (A) which controls the roll, pitch, and yaw of the ultrasound probe, the flexible belts (B), and the fastening plate (C) which are used to secure the belts

PRACTICAL APPLICATIONS

Using the **Cubic Spline Interpolation** equation in **conjunction** with the **PGT** and **TRAD** technique is a **reliable measure** of VL muscle volume

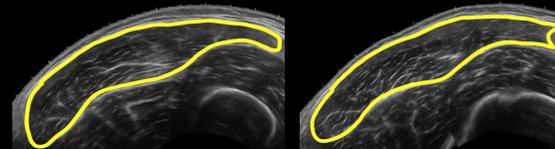*Figure 2a.* Example of the 3D printed probe guide used in the PGT trials.

Figure 2b. Example image with the TRAD (left) and PGT (right) techniques for trial 1

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 (LOGIQ e R10.1, General Electric Company, Boston, MA, USA) of the vastus lateralis (VL)
- Four data collection trials (2 PGT, 2 TRAD) were performed each separated by 10 minutes
- ACSA scans were taken along the length of the VL 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 VL
- Muscle volume was estimated using the cubic spline interpolation technique with the ACSA scans[2]

$$MV = \times \sum_n e_i \times S(CSAi, D)$$

RESULTS

- The PGT method indicated excellent reliability (ICC$_{2,1}$ = 0.971)
- The TRAD technique demonstrated excellent reliability (ICC$_{2,1}$ = 0.987) with a lower amount of error (SEM% = 2.96%)

Vastus Lateralis Muscle Volume

	ICC$_{2,1}$	SEM (%)	MD (cm^3)
PGT	0.971	4.67	9.16
TRAD	0.987	2.96	5.81

Table 1. Test-retest reliability statistics for VL muscle volume for the PGT and TRAD

CONCLUSION

- The findings suggest that the PGT TRAD methods are reliable when quantifying muscle volume Although the two methods exhibited excellent reliability
- The TRAD technique may have less error and variability between repeated scans compared to the PGT
- Future studies should assess the utility of this approach with other muscles and with technicians of varying experience levels

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