TEST-RETEST RELIABILITY OF PERIPHERAL QUANTITATIVE COMPUTED TOMOGRAPHY TO EXAMINE THIGH MUSCLE CROSS-SECTIONAL AREA IN YOUNG MEN AND WOMEN

Nicholas A. Buoncristiani[1], James R. Merritt[2], Evangeline Souci[3], Hayden K. Giuliani-Dewig[4], Gena R. Gerstner[1], Abbie Smith-Ryan[1], Brian G. Pietrosimone[1], Eric D. Ryan[1]

[1]The University of North Carolina at Chapel Hill, Chapel Hill, NC; [2]Gatorade Sports Science Institute, Valhalla, NY; [3]The University of North Carolina Rex Cancer Center, Raleigh, NC; [4]West Virginia University, Morgantown, WV

INTRODUCTION

- Assessments of skeletal muscle size are commonly used to examine the impact of training, disease, and rehabilitation on muscle function (1,2).
- Peripheral quantitative computed tomography (pQCT) is a novel, low-radiation alternative to computed tomography to assess muscle cross-sectional area (CSA) (3).

PURPOSE

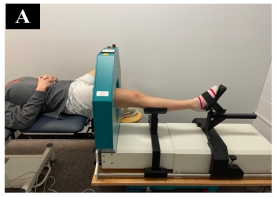
- The purpose of this study was to examine the test-retest reliability of pQCT-derived midthigh measures of muscle CSA and lean muscle CSA.

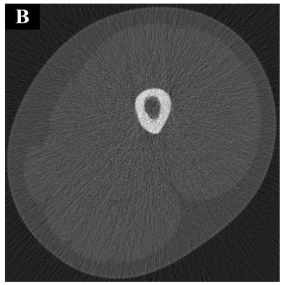
METHODS

- Twenty healthy participants (10 females; mean ± SD age= 21.3 ± 1.5 yrs, BMI= 24.1 ± 2.6 kg/m^2) enrolled in the study and reported to the laboratory on two separate occasions (separated by 2 – 7 days; ± 2 hrs).
- Participants were required to refrain from any vigorous lower body exercise for 48-hours prior to testing and to abstain from alcohol or recreational drug use for 24 hours prior to testing.
- All females took a pregnancy test prior to testing and were examined in the early follicular phase of their menstrual cycle.
- Mid-thigh images were acquired at the midpoint between the greater trochanter and lateral epicondyle while lying supine on an examination table (Figure 1. A.).
- Automated enclosing convex polygon approach segmented tissues allowing for muscle CSA and lean muscle CSA quantification (Figure 1. C) (4).

STATISTICAL ANALYSIS

- A one-way repeated measures analysis of variance was used to assess systematic error between days, along with intraclass correlation coefficients (ICC$_{2,1}$) and standard error of the measurement (SEM) to calculate absolute and relative consistency, respectively (5).
- Minimum difference (MD) values (i.e., amount of change needed to be considered real) were also calculated (5).





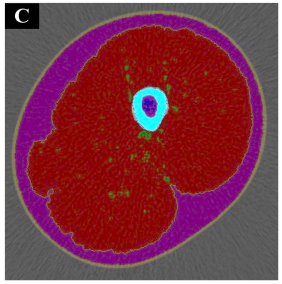


Figure 1. An example of A) participant set up in the scanner; B) mid-thigh scan from STRATEC software; C) mid-thigh muscle CSA scan using convex polygon approach in ImageJ.

RESULTS

- There was no systematic error across days (P=0.41) (14,744 mm^2 ± 4,145 mm^2) vs. (14,813.6 mm^2 ± 4,183.1 mm^2) for muscle CSA or lean muscle CSA (P=0.60) (14,281.5 mm^2 ± 4,026.1 mm^2) vs. (14,427.8 mm^2 ± 4,053.4 mm^2).

Table 1. Test-retest reliability statistics for peripheral quantitative computed tomography derived midthigh measures of muscle and lean muscle CSA.

	Muscle CSA (mm^2)	Lean Muscle CSA (mm^2)
ICC$_{2,1}$	0.996	0.993
SEM (mm^2)	260.6	352.1
SEM (%)	1.8	2.5
MD (mm^2)	722.5	976.1

CONCLUSION

- This study indicates that pQCT has acceptable consistency values when examining midthigh muscle and lean muscle CSA in young men and women, as seen in previous studies (6).
- Data suggest that changes of 722.5 mm^2 for muscle CSA and 976.1 mm^2 for lean muscle CSA are needed for real change.

PRACTICAL APPLICATIONS

- Researchers and strength and conditioning practitioners could use pQCT to examine changes in thigh muscle and lean muscle CSA following interventions, injury, and/or disease.
- The MD values could give practitioners criteria to determine the effectiveness of a training protocol on muscle CSA.

REFERENCES

1. Lynch NA, Metter EJ, Lindle RS, et al. Muscle quality. I. Age-associated differences between arm and leg muscle groups. *J Appl Physiol (1985)*. 1999;86(1):188-194.doi:10.1152/jappl.1999.86.1.188
2. Phillips SK, Rook KM, Siddle NC, Bruce SA, Woledge RC. Muscle weakness in women occurs at an earlier age than in men, but strength is preserved by hormone replacement therapy. *Clin Sci (Lond)*. 1993;84(1):95-98. doi:10.1042/cs0840095
3. Wong AKO, Beattie KA, Min KKH, et al. A tri-modality comparison of volumetric bone imaging technologies. Part I: Short-term precision and validity. J Clin Densitom. 2015;18(1):124-135. doi:10.1016/j.jocd.2014.07.005
4. bonej.org :: User Guide - pQCT Density Distribution. Accessed June 16, 2023. https://bonej.org/densitydistribution
5. Weir JP. Quantifying test-retest reliability using the intraclass correlation coefficient and the SEM. J Strength Cond Res. 2005;19(1):231-240. doi:10.1519/15184.1
6. Herda, AA, Herda, TJ, Costa, PB, Ryan, ED, Stout, JR, and Cramer, JT. Muscle Performance, Size, and Safety Responses after Eight Weeks of Resistance Training and Protein Supplementation: A Randomized, Double-Blinded, Placebo-Controlled Clinical Trial.