Wireless Ultrasound Probes: A New Frontier in Assessing Femoral Cartilage Health

Parmar AS[1], Grozier CD[1], Tolzman JE[1], Dima R[2], Winn B[3], Hacihaliloglu I[4], Fajardo R[5], Harkey MS[1]

Michigan State University[1], Western University[2], Nike Sport Research Lab[3],University of British Columbia[4], Lansing Radiology Associates[5]

AIR LABS
ATHLETIC INJURY AND REHABILITATION

INTRODUCTION

- Recent advancements in wireless ultrasound technology allows for point of care cartilage imaging
- However, validation between wireless and standard ultrasound units remains to be established for knee cartilage outcomes
- **Purpose**: Estimate agreement of articular cartilage thickness and echo-intensity between standard and wireless ultrasound

METHODS

Cross-sectional study: DI female athletes.

N	Height (cm)	Mass (kg)	Age (years)
71	171.7 ± 8.7	69.4 ± 11.0	20.0 ± 1.3

Knee Positioning

- Supine; maximum knee flexion

Probe Placement

- Transverse suprapatellar centered to the trochlear groove

Standard Ultrasound Unit

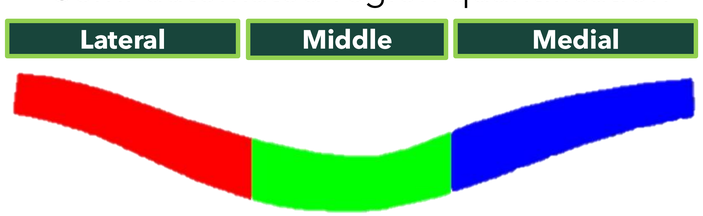
- GE LOGIQ P9 R3, Fixed Gain, 4cm depth

Wireless Ultrasound Unit

- Clarius L15, Auto Gain, 4cm depth

Segmentation

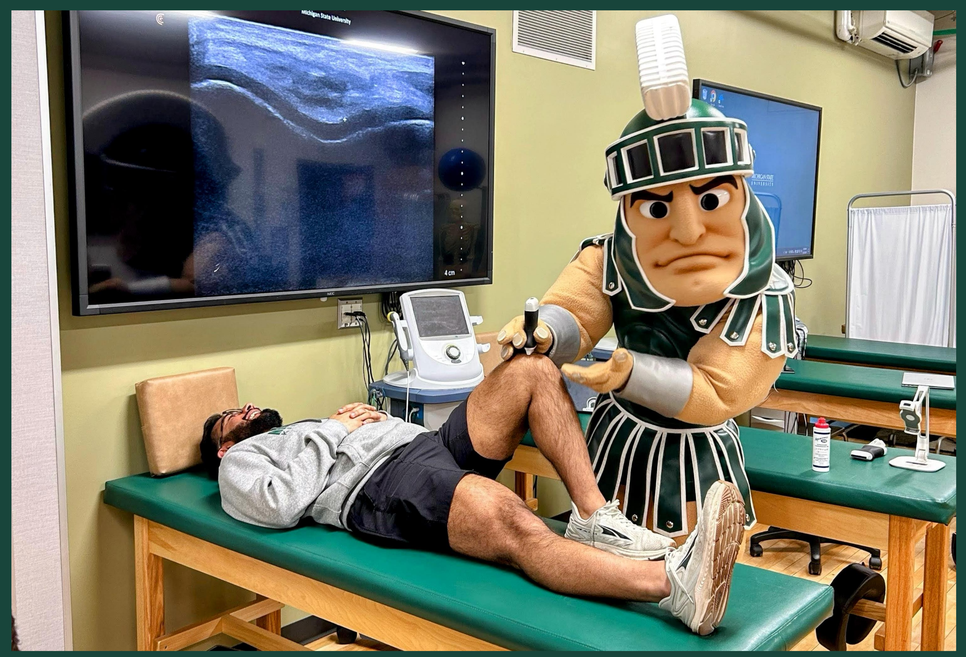
- Manual global segmentation
- Semi-automated region quantification

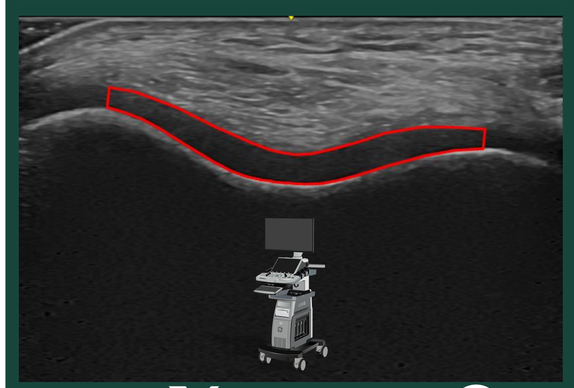


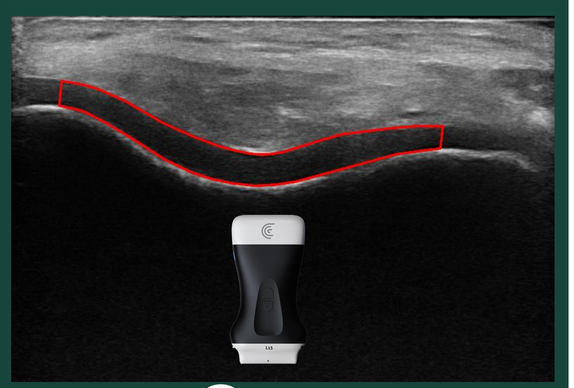
Pixel Normalization

- Image J's "Stack Normalizer" was used to perform a linear algebraic scaling of pixel values to the image maximum and minimum pixel values

Wireless Ultrasound Agrees With Standard Units In Cartilage Thickness But Not In Echo Intensity Measurements







@Ajparmar_ @ArjunParmar9 @Ajparm

STATISTICS

- Intraclass correlation coefficients ($ICC_{2,k}$) for absolute agreement

RESULTS

Item	Standard	Wireless	ICC(2,k)
Global			
Thickness	2.16 (0.36)	2.18 (0.34)	0.95
Raw Echo Intensity	41.55 (5.46)	34.61 (6.58)	0.57
Normalized Echo Intensity	35.61 (6.38)	38.90 (8.07)	0.45
Medial			
Thickness	2.11 (0.38)	2.15 (0.36)	0.88
Raw Echo Intensity	45.31 (6.64)	39.51 (8.36)	0.68
Normalized Echo Intensity	40.00 (8.18)	45.28 (9.90)	0.58
Middle			
Thickness	2.39 (0.45)	2.41 (0.46)	0.91
Raw Echo Intensity	34.59 (5.70)	29.60 (7.40)	0.68
Normalized Echo Intensity	27.66 (6.29)	33.48 (8.33)	0.48
Lateral			
Thickness	2.03 (0.36)	2.04 (0.34)	0.94
Raw Echo Intensity	44.24 (6.68)	34.31 (8.15)	0.43
Normalized Echo Intensity	38.75 (7.60)	39.18 (9.66)	0.50

DISCUSSION

- Cartilage thickness measurements demonstrate strong agreement
- Cartilage echo-intensity measurements demonstrate poor agreement
- Algebraic pixel normalization did not improve echo-intensity agreement or alter thickness
- Future studies should investigate the use of unnormalized channel data to minimize the effects of unit specific processing to create B-mode images

arXiv **Preprint Article**