Using Ultrasound-Guidance to Teach Access and Drainage of Synthetic Cysts in Formalin Embalmed Cadavers

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INTRODUCTION

Residents and medical students have reported that they do not receive adequate training and feel unprepared to perform invasive types of procedures on patients during residency (1).

Ultrasound (US) guidance stands out as a universally applicable skill that decreases complication rates and increases success rates in new learners when used to guide procedures (2–6). Its use spanning multiple clinical disciplines, is low risk to patients, and is readily accessible to novice users.

Formalin-embalmed cadavers are available at many medical education institutions and can be used to create realistic, cost effective, and low stress training simulations in ultrasound-guided procedures (11,12).

AIMS

Primary aim: to develop a practical, realistic, and inexpensive method of teaching medical students to perform US-guided access and drainage of synthetic cysts in formalin embalmed cadaver tissue.

Secondary aim: assess changes in student skills and self-confidence following training with cadavers, and explore correlations between instructor type and student skills and confidence outcomes

METHODS

Equipment
- Three Mindray MX7 ultrasound systems equipped with L12-3RC linear transducers (Mindray Global, Shenzhen China) were used to guide 18g 2-inch hypodermic needles on 30cc syringes during cyst access and drainage.

Subjects
- 30 Geisel School of Medicine at Dartmouth College students. Approval of the study was granted by Dartmouth Committee for the Protection of Human Subjects (#00032735).
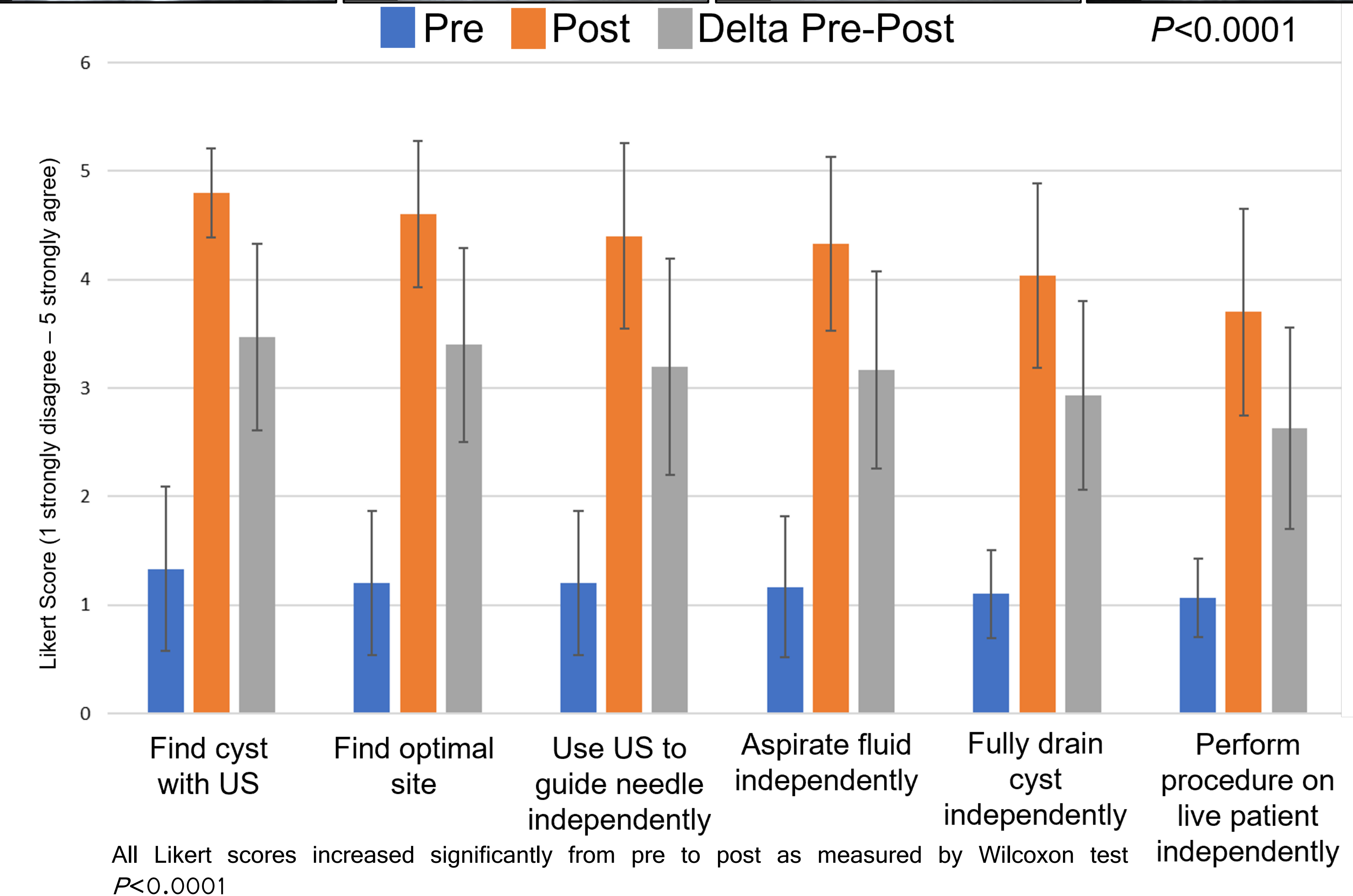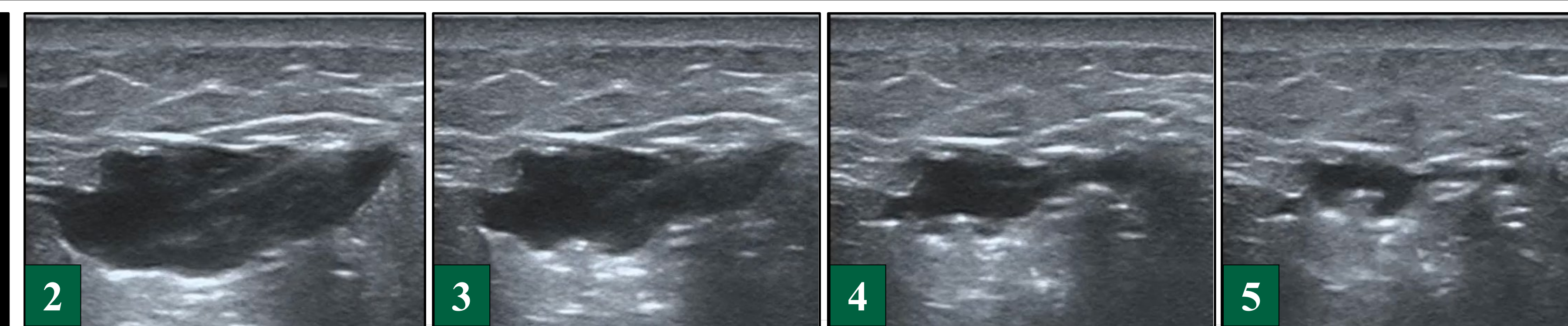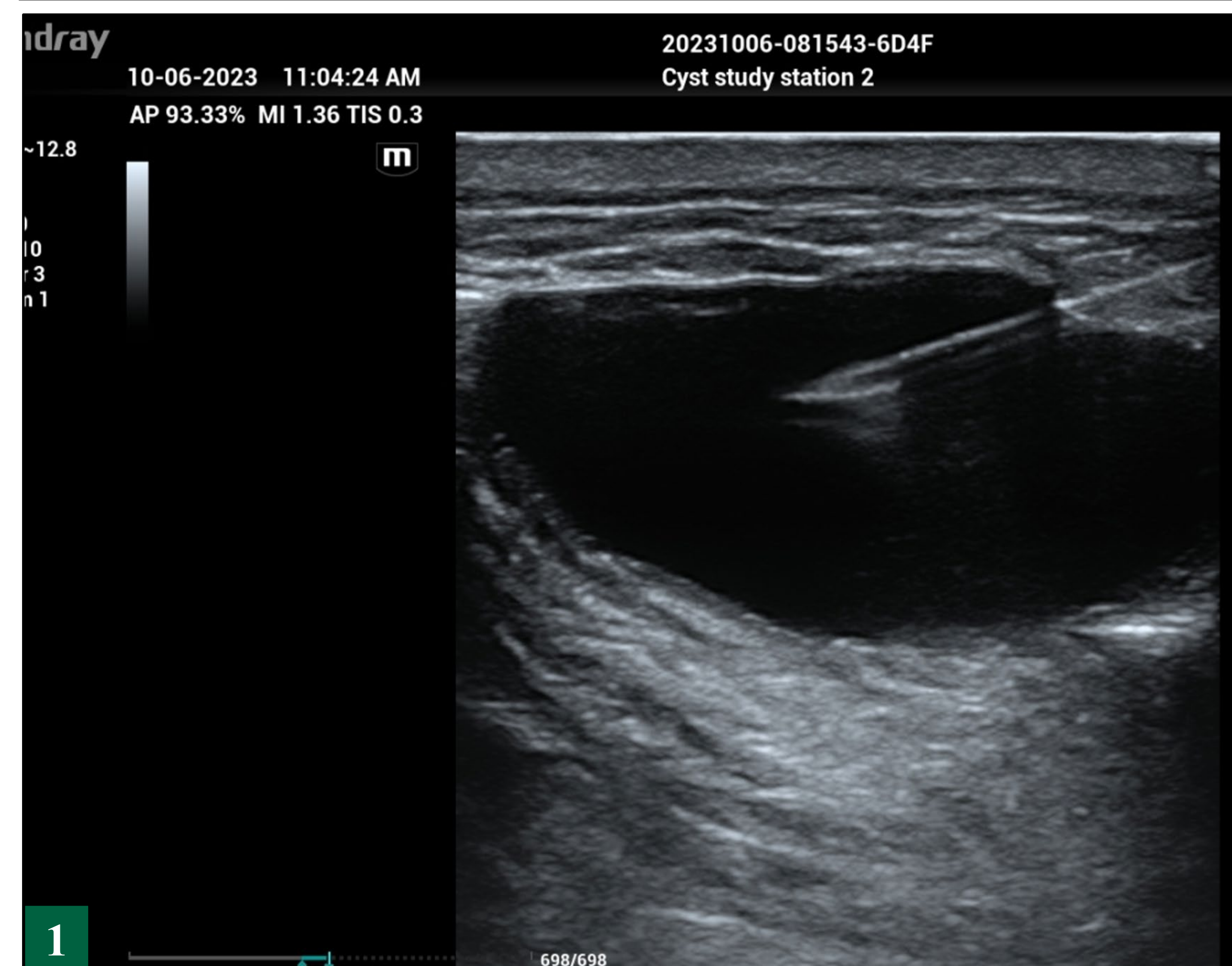
Procedure
- Participants took a pre-training survey that used a 5-point Likert scale to gauge their self-confidence in performing various aspects of the procedure, gathered demographics, and experience level with ultrasound. Next, participants watched a 15-minute training video covering the basics of imaging synthetic cysts and the steps required to drain them under ultrasound-guidance. During the training workshop, participants were allotted 20 minutes to use a procedure simulation station to practice the procedure in a low stress, low stakes environment with one-on-one instructor, (instructor types included: physician, anatomist, or medical student) three synthetic cysts, and unlimited attempts to practice the procedure.
- Participants were given 5 minutes, and three cysts to pass a skills assessment during which they were required to image and drain ("full drain" was defined as ≈15-20 CCs as confirmed by the instructor) of the fluid from a cyst independently. Metrics regarding performance was recorded by an instructor using a procedure assessment rubric previously validated global ratings scale (13)
- Following skills evaluation a post-training survey was administered. Questions on this survey mirrored the pre-training survey with the addition of an open-ended opportunity for participants to share their thoughts regarding the training program.

Statistics
- All statistical analysis were performed using SAS/STAT v.9.4 Descriptive statistics were calculated using proc FREQ for categorical variables and PROC MEANS for continuous variables. Association testing of categorical variables was evaluated using contingency tables with an Exact test using PROC FREQ and association testing for categorical/continuous variables was performed using PROC GLIMMIX, residual distribution fit was assessed using log likelihood estimates (Lowest). Statistical significance was declared at P<0.05.

RESULTS

All Likert scores increased significantly from pre to post as measured by Wilcoxon test P<0.0001

Skills Test Variable	Mean
Procedure time (probe to skin to full drain)	161.5 seconds
Attempts (number of needle sticks to succeed)	1.9 attempts
Number of failures (could not complete in time limit)	2

Variable	Test type	P-value (showing effect of instructor type on participant skills test score)
Time to complete (seconds)	Linear model (Gaussian)	0.4130
Number of attempts	Linear model (negative binomial)	0.8909
Respect for tissue	Linear model (negative binomial)	0.6072
Time and motion	Linear model (negative binomial)	0.5172
Instrument Handling	Linear model (negative binomial)	0.5201
Flow of procedure	Linear model (negative binomial)	0.8169
Knowledge of procedure	Linear model (negative binomial)	0.7602
Overall performance	Linear model (negative binomial)	0.6393
Pre training overall confidence (Sum)	Linear model (Gaussian)	0.1663
Post training overall confidence (Sum)	Linear model (Gaussian)	0.3909
Difference pre- post training overall confidence (Sum)	Linear model (Gaussian)	0.4471

CONCLUSIONS

- The ultrasound images of the synthetic cysts within formalin-embalmed (FE) tissue are very clear and realistic, with excellent needle visibility during access and drainage.

- Medical trainees can use this method to practice cyst drainage under US-guidance and effectively learn to perform the procedure through realistic and repeated practice in a low stress environment that is free from any potential patient discomfort.

- Practice with FE cadavers significantly increased student confidence in every measured category

- The type of instructor a student was assigned to had no statistically significant effects on their skills performance or confidence.

REFERENCES