

Point-of-care Ultrasound in Sports Medicine:

A Playbook for Maximum Impact Deployment

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“Ultrasound allows the sports medicine provider to see the injury right now!”

Point-of-care ultrasound (POCUS) is a well-established but historically under-utilized¹ imaging modality in sports medicine. Although use of POCUS for the evaluation of musculoskeletal injuries and treatment is evidence-based, required in sports medicine fellowship training, and offers specialized certification, its incorporation is uncommon¹. This suggests that there are adoption barriers that must be addressed.

This playbook is designed to provide solutions to barriers of ultrasound adoption frequently encountered by sports medicine providers. We will “play-by-play” the actions we took to successfully incorporate POCUS into the sports medicine team (physician, PT, athletic training staff) to better serve our athletes. At our institution, POCUS has supported pre-participation physical exams, helped accelerate diagnosis, prompted treatment, and facilitated a quicker return to play.

Identify Need

The sports medicine team provides first-line treatment for athletes during practice and competition events. Injuries can range from simple strains to life-threatening injuries. The majority of injuries in sport are non-emergent and musculoskeletal in nature.

Before incorporating ultrasound, the sports medicine team relied heavily on MRI in the context of a thorough clinical exam to diagnose injuries. Obtaining MR images can be both

time-consuming and costly compared to obtaining ultrasound images^{2,3}. Yet, the modalities are comparable in their sensitivity and specificity for many common musculoskeletal injuries³. In addition, a dynamic exam is contraindicated in MR imaging. POCUS allows an immediate, low-cost dynamic evaluation to be performed in parallel to the physical exam.

The advancement of technology has enabled greater portability of ultrasound. A Butterfly iQ can be kept in the side pocket of a game bag and be readily available on the bench, on the sideline, or in the athletic training room. In addition, the cost of an ultrasound unit has dropped from 6 figures to a few thousand dollars.

The cloud-based image storage feature now available with POCUS addresses communication barriers among sports medicine professionals. One could always discuss a “grade 1 hamstring injury” with a colleague, but now, an image can be shared via email or text message that shares both images and video of the injury, allowing a colleague to view the injury in question. This access leads to improved communication between the athletic training staff and physicians, resulting in a more rapid and accurate consultation. Acquiring images earlier and rapidly sharing findings can ultimately result in quicker rehabilitation and return to play.

*Experience of 1 institution. Individual results may vary, and have not been validated by a clinical trial.

“Actually seeing the injury live with POCUS can help me to decide whether or not to play through it.”

—Kaleb Michael Roper, Chicago White Sox

Have a Solid Game Plan

Tulane Institute of Sports Medicine and Center for Sport at Tulane University has successfully implemented POCUS into the Tulane University Athletics Department in New Orleans, Louisiana. The physicians at Tulane Institute of Sports Medicine are responsible for the care of ~400 NCAA Division 1 athletes. Candidly, we share the learnings, hurdles, and strategies involved in the implementation of POCUS. Planning is key. Passion is essential.

Step 1.

Define your vision

To use POCUS in the appropriate clinical context to:

1. Identify the anatomical structure of musculoskeletal injury
2. Grade the severity of the injury
3. Share findings with the sports medicine team
4. Direct specific localized treatment to the area of injury
5. Follow rehab progression
6. Reduce the cost of athlete care
7. Utilize POCUS as a recruitment tool for new athletic talent

Step 2.

Define the stakeholders

A lead sports medicine physician with adequate ultrasound training and experience is key to making POCUS deployment work. This physician must be motivated to teach and demonstrate proper POCUS evaluation techniques.

Athletic programs vary in their structure. However, the sports medicine team will have at least one physician and one head athletic trainer. A buy-in from these two health professionals is critical. The physician is charged with teaching staff how to use the ultrasound unit and reviewing their studies as necessary. They serve as the clinical stakeholder and expert for the project.

The head athletic trainer’s involvement is necessary to adopt POCUS into the training workflow. Their responsibilities might include supervising daily use of the ultrasound unit, storing images, documenting brief reports, or relaying relevant studies to the team physician. The head athletic trainer should ensure ultrasound is used frequently in the athletic training room to build competency among the athletic training staff. Under the physician and head athletic trainer’s guidance, the entire sports medicine physician team, athletic training staff, and physical therapy staff are encouraged to learn POCUS and incorporate it into their care.

Finally, the Athletic Director and Head Coach should be involved, and buy into the investment in the ultrasound unit and supporting continuing education. The return over time will be significant player satisfaction, quicker return to play, and long-term cost reduction to the athletic department.

Step 3.

Overcome Barriers

There can be significant institutional, financial, and logistical barriers to incorporating POCUS into sports medicine practice. Here is a list of the barriers we faced and our approach to overcoming them.

1. Abiding by State Practice Acts

Before incorporating POCUS into a sports medicine practice, your practice should check with your health professionals' respective state licensing board to ensure use of diagnostic ultrasound falls within their scope of practice. Every sports medicine team must have a lead physician who will oversee POCUS training and review scans. If POCUS is not in the scope of practice of the athletic trainer in your region, physician oversight may be adequate. A physical therapist with a certification in MSK ultrasound might also be able to provide oversight. Physicians are advised to review every scan that is relevant to medical treatment or will be entered into an athlete's medical record.

2. Training Logistics

Every sports medicine team must identify a lead physician who can champion POCUS training. Optimally, every member of the team should attend a basic ultrasound course. Thorough hands-on instruction is important to learn the nuances of scanning techniques and image recognition. The lead physician can then provide ongoing proficiency training by supervising scans in the athletic training room and during athlete patient visits. For example, when an athlete visits the physician's office for a sprained ankle, the lead physician should allow extra time to provide just in time (JIT) teaching to the athletic trainer. The physician can demonstrate identification of key structures, such as the ATFL and allow the athletic trainer to repeat the exam under supervision. During training, stress that POCUS is not a cure-all — you cannot rely only on an ultrasound evaluation to assess athletes. Of foremost importance is the direct application of basic sports medicine history taking and physical examination. POCUS is used to augment the physical exam.

With the Butterfly iQ, the athletic trainer and physician can use the TeleGuidance feature. This allows the athlete to be assessed on the sideline or athletic training room while the physician is elsewhere. This can result in a quicker diagnosis and a reduction in physician clinic visits*.

It can take months to years to become confident with using POCUS. However, like any sport or skill, the more you practice, the faster your skills will grow.

3. Emphasizing use in the training room

The athletic training room can get busy, especially during an active season. Even during busy times, an ultrasound should not sit in the back and collect dust. The training staff should use their ultrasound to evaluate as many injuries as possible. It should become a habit to use the ultrasound to evaluate new musculoskeletal injuries. In the early phases of ultrasound training, the evaluator should practice proper technique, structure identification, and labeling, to share with the lead physician and receive feedback. Each member of the athletic training staff should keep a log, including date, injury, and structure scanned.

You might notice a slight decrease in efficiency when evaluating athletes in the early phases of implementing POCUS. This is to be expected; it is still new. As staff's comfort and competency increases, scanning time will improve.

4. Performing Exams Under Supervision

Exams should be performed on a regular basis under physician supervision. At Tulane, an athletic trainer performs exams under physician supervision during athlete patient visits and during downtime at sporting events. We conduct presentations for our medical colleagues at 'Grand Rounds.' Topics include a review of regional scanning techniques, normal regional anatomy, pathology, and hands-on scanning sessions. The lead physician provides a critique on technique, image quality, and labeling for all shared and saved images.

We have recently begun to incorporate the Butterfly iQ's TeleGuidance as a teaching tool for video conferencing sessions. We can livestream an example knee exam that the entire sports medicine team can view from anywhere.

“Although challenging, incorporating ultrasound into your athletic department is a tremendous breakthrough in the care of athletes.”

*Experience of 1 institution.

Individual results may vary, and have not been validated by a clinical trial.

5. Refresher training

Refresher training can also be a barrier to incorporation. We have learned that refresher training is best done in small, quick sessions throughout the year to accommodate the sports medicine staff's busy schedules. Refresher sessions should be tailored to common injuries seen during a particular sports season. For example, a shoulder scanning session would be demonstrated during baseball season, while an ankle scanning session should be planned during basketball season.⁷

6. Quality review

Quality of ultrasound scans can dwindle quickly if not closely monitored. Therefore, the lead physician should schedule quality reviews at least twice annually with athletic trainers involved in scanning. During the review session, the lead physician should review scans performed over the past few months and provide feedback. These review sessions should be documented to further support the competency of the athletic training staff.

7. Equipment Selection

Fortunately, technology has enabled greater portability without a significant decrease in image quality. Butterfly iQ has moved away from traditional piezoelectric crystals and implemented a silicon chip-based system. This technological advancement has offered scanning features never before seen in an ultrasound unit and provides durability and portability. The Butterfly iQ can easily be added to a sideline injury bag and plugged into an iPhone or iPad. My personal unit fits perfectly in my briefcase and team physician bag. While we are careful with the unit, we do not have the same angst as one would feel after dropping a traditional probe with fragile crystals. In addition, a single Butterfly iQ probe can visualize multiple depths, preventing the need for multiple probes.

8. Image Storage

Image storage can require hard drives, multiple systems, and cumbersome technology. To best ensure an efficient POCUS workflow, cloud storage is necessary. It is cumbersome and time consuming to download images to a USB drive as a backup. It is also a risk to leave images on the machine as they can easily be lost. Therefore, the unlimited cloud storage available with Butterfly iQ is optimal for worry-free and secure storage that can be retrieved for review, training sessions, or audit.

9. Wireless Connectivity

Because of the mobile nature of a sports medicine team, wireless connectivity is a must. The team should have an ultrasound system with wireless connectivity to relay

images to the lead team physician who may be on the sideline while the athlete and trainer are in the training room. An ultrasound system with cellular connectivity can send images from an away game to the lead physician who may not have traveled. Butterfly iQ relies on a mobile device's cellular network, allowing easy communication regardless of location.

10. Documentation of Findings

Documentation of findings should be easy and intuitive, as a POCUS evaluation may be performed in rushed, high-stress environments. A POCUS system should have an interface that allows the trainer to document findings quickly and efficiently.

11. Relay of Relevant Clinical Information

A picture is worth a thousand words, but for ultrasound, the picture is best communicated with clinical context. Ideally, relevant clinical information should be provided with the image or during the time of the exam. We take advantage of Butterfly iQ's TeleGuidance feature that allows us to communicate both images and relevant clinical information through easy-to-use video imaging and microphone. The lead physician can see the surface anatomy and ultrasound images of the athlete while speaking real-time to the scanning athletic trainer. In addition, Butterfly's sharing functionality allows for clinicians to text or email the image and any relevant details easily and quickly.

12. Cost of Equipment

A POCUS unit should be relatively low-cost. It is not reasonable to travel with an expensive and fragile ultrasound unit. Competent ultrasonography can reduce the utilization of MRI, significantly reducing the overall cost of care. When presenting the budget to leadership, highlight the decreased cost as a result of POCUS, understanding that a portable ultrasound like the Butterfly iQ is an investment in preventative care and has the potential to decrease a department's overall spending*.

*Experience of 1 institution. Individual results may vary, and have not been validated by a clinical trial.

Do It Right

It may seem daunting to build competency and education into an already rigorous sports medicine schedule that involves extensive hours of rehab, travel, and game coverage. The sports medicine team must dedicate time to study ultrasound and use it in a physician-supervised setting, and coordinating schedules is never simple.

But over time, our findings motivated us to move past the barriers described above. We realized that we were identifying many injuries that were not seen well with other imaging modalities. The cost of imaging for the Tulane Athletic Department was drastically reduced, and the delivery of care was more efficient. We are now able to offer imaging within minutes after an injury. Finally, we particularly noted the benefit of using POCUS to both identify chronic hamstring injuries and offer prompt fascial hydrodissection treatments to our athletes.⁸

Second Half Adjustments

Since introducing POCUS into the Sports Medicine program over a year ago, we have identified key aspects to maintaining successful incorporation of ultrasound use in the athletic training room:

1. Develop a program for new staff incorporation. As graduate students move on and junior-level staff members get promoted, turnover occurs, and new staff join the team. It is important to provide an “onboarding” ultrasound lesson for new members. Other athletic training staff who are more comfortable with POCUS should be motivated to teach new staff.
2. Choose a reference textbook. There are many fantastic ultrasound books available. However, we have learned that textbooks should be available online and easily viewed on a mobile device. Many online references now include videos that make learning easier.
3. Communicate, communicate, communicate. Share images with your colleagues and lead physicians. Ask for feedback. Sharing images is easily accomplished with the use of the Butterfly cloud and TeleGuidance. In non-urgent situations or when the physician is not available for image viewing, Butterfly Cloud should be leveraged. The athletic trainer will alert the physician that a new injury has occurred, and the images are available for review. If the physician is available or an injury is urgent, TeleGuidance can be used to provide real-time evaluation of surface anatomy and an ultrasound image.
4. Negotiate funding. It may be useful to identify MRI images taken during the past season and determine which injuries may have been identified and managed without the use of MRI, such as patellar or Achilles tendinitis⁹. Do the math: three to four fewer MRI scans can likely cover the cost of purchasing a Butterfly iQ unit and a year of cloud storage.

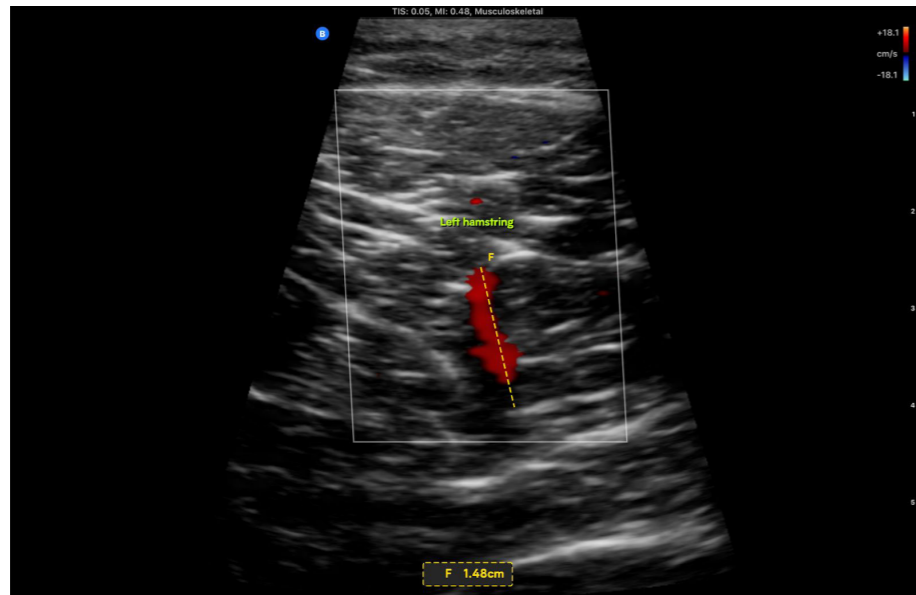
*Experience of 1 institution. Individual results may vary, and have not been validated by a clinical trial.

The Home Run

Below are 2 clinical examples of how we have incorporated POCUS into the clinical workflow of our athletic program. They illustrate the change in athlete management that was possible as a result of integrating POCUS into our physical exam.

Case 1 - The Hamstring Strain

An 18-year old high school football player reports to the athletic training room following the game. The athlete reports pulling his left hamstring in the mid 3rd quarter, but managed to continue to complete the game. Now that the game is over, he feels his left hamstring “getting tight.” Following the game, the athletic trainer obtained an ultrasound image using the Butterfly iQ.



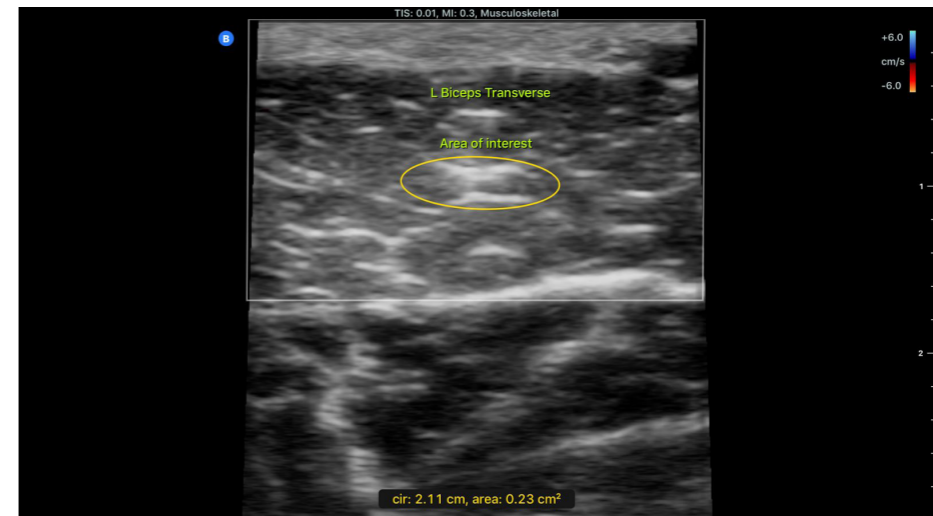
Short axis image of the left semimembranosus and semitendinosus muscles taken with the Butterfly iQ.

The MSK - Soft Tissue setting was chosen, and the probe was placed over the maximum area of tenderness. The POCUS evaluation revealed reactive hyperemia (red signal noted on the ultrasound image) in the semimembranosus, which is consistent with an acute strain in the muscle belly. There is also slight reactive hyperemia in the more posterior semitendinosus. The athlete immediately underwent an ultrasound-guided injection conducted by the team physician and returned to full practice three days later pain-free.

In this one case, the Butterfly iQ saved the high school athletic department the cost of a clinic visit, MRI, and subsequent treatment. The total cost of the care avoided was approximately

\$2,000. This single case recovered the cost of the ultrasound unit for the athletic department.

“...this single case recovered the cost of the ultrasound unit for the athletic department”



Transverse image of the left biceps muscle taken with the Butterfly iQ.

Case 2 - Undiagnosed Arm Pain in a Baseball Player

A 22-year old college baseball pitcher reported right anterior arm pain for 18 months. Pain occurred in the early acceleration phase of throwing and was localized to the biceps. He visited multiple physicians who could not identify a clear etiology. Two MRIs and electromyography with nerve conduction studies were normal. He was referred to our clinic and underwent an ultrasound using the Butterfly iQ.

The Musculoskeletal preset was selected, and the ultrasound probe was placed over the area of maximal tenderness. The physician noted a thick area of fascia within the muscle belly. Under ultrasound-guidance, the athlete underwent a fascial hydrodissection. He returned to pitching the following week with full resolution of bicep pain and tightness.

This case highlights the unique ability of POCUS to identify acute and chronic soft tissue abnormalities that MRI may not. It also highlights the usefulness of POCUS during a dynamic physical examination. In the clinic, the athlete identified the area of discomfort, and the probe was placed directly over the area of interest. The physician then palpated the area with the ultrasound probe, which reproduced symptoms.

The total cost of care was estimated to be ~\$6000, the equivalent of 3 Butterfly iQ probes. If POCUS were used initially, the athlete may well have had an earlier diagnosis and treatment, resulting in a quicker return to activity.

Cardiac Screening Program

Tulane University's Department of Athletics uses the Butterfly iQ to perform pre-participation echocardiograms on all athletes. The extensive and expensive cost of an echocardiogram makes it difficult to obtain one for hundreds of asymptomatic athletes. Therefore, physicians rely on stethoscope auscultation. However, sensitivity in detecting cardiac abnormalities remains low¹⁰. An echocardiogram is a far superior modality for detecting cardiac abnormalities, particularly those that can result in sudden death.

At Tulane Athletics, we obtain baseline echocardiograms for every incoming athlete. A echocardiographer volunteers their time to perform the studies, which are then reviewed by the team cardiologist. The images are saved in the Butterfly Cloud. In the event an athlete has a cardiac symptom, the baseline echocardiogram is readily available for comparison. Having an image readily available may offer benefit to an evaluating physician¹¹, particularly if the athlete develops a cardiac symptom while competing out of town. Particularly relevant is the ability for recovering COVID-19 athletes to have a repeat echocardiogram to ensure that cardiac structural damage has not occurred.

“POCUS is instrumental in early evaluation and monitoring of potential and confirmed myocarditis in athletes during the COVID-19 pandemic.”

—Gregory Stewart

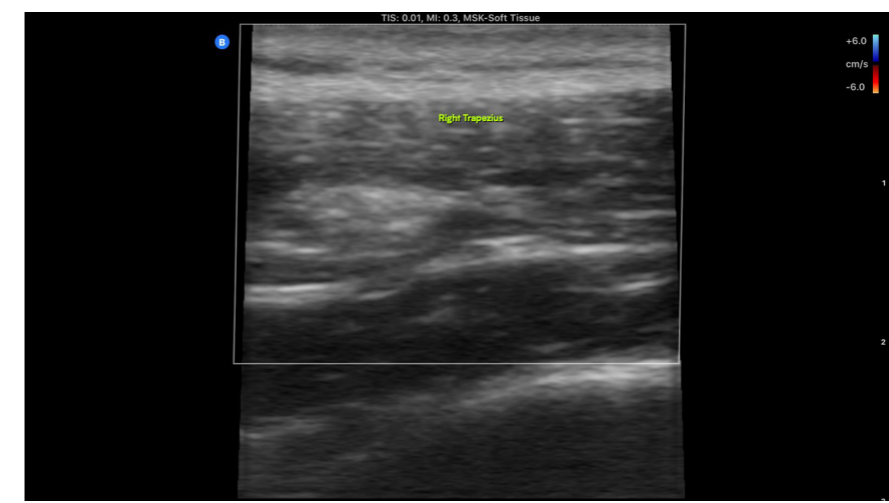
MD Medical Director, NFL Player Care Foundation's Healthy Body and Mind Screening Program
Director, Tulane Brain and Body Evaluation Program through The Trust, powered by the NFL
Players Association

Conclusion

Given our positive experience and learnings along the way, I have no doubt that sports medicine incorporation of POCUS into the athletic training room will lead to better care¹. In fairness, due to the fast-paced and busy nature of sports medicine, it will be a challenge for any sports medicine practice to take the time for education and implementation. However, once implemented, the return on investment may include benefits as valuable as a faster return to play, improved athlete satisfaction, better communication of injuries among the sports medicine staff, and decreased cost of care.

As a clinician, the real value for me is in the tremendous impact we have observed with the performance of POCUS on our athletes. I am compelled to share a final case of a Tulane football player with an acute neck injury. He made a great tackle, but returned to the sideline complaining of right-sided neck pain. We fully evaluated him in the sideline tent, and fortunately his neurological exam was normal and there was minimal concern of a fracture. The physical exam only revealed local tenderness to palpation at the base of his right neck. We removed his shoulder pads and performed an ultrasound evaluation at the base of his neck, which revealed a small, acute muscle strain (reactive hyperemia) in the trapezius as seen in the image below:

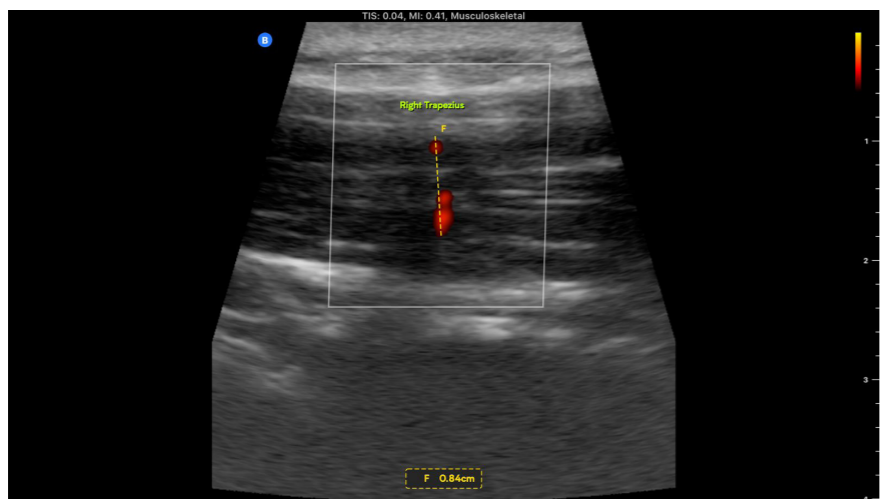
After the athlete realized his pain was secondary to a muscle strain and not a more serious cervical spine injury, he returned to the field. He played the remainder of the game without an issue. Following the game, the athletic training staff immediately began his rehabilitation and he recovered quickly. His follow up ultrasound evaluation 5 days later no longer revealed an injured trapezius. Note the absence of reactive hyperemia:



Right trapezius image taken with the Butterfly iQ.

Prior to POCUS implementation in our program, this would have been his care pathway:

- The athlete would have received an immediate cervical spine x-ray, which we can reasonably predict would have been normal, offering little or no insight into neurological or soft tissue injury.
- He would have missed significant playing time during transport to and from the x-ray suite.
- Even in the context of a normal x-ray, the athlete likely would not have felt comfortable returning to play without an explanation, and likely would have received an MRI to further evaluate the injury.
- It is extremely unlikely that the MRI would have identified the small strain in his trapezius.
- The athlete may have lost additional playing time and not received an explanation for his pain.



Longitudinal image of right trapezius image taken with the Butterfly iQ.

¹ Experience of a singular institution, yet to be validated by extensive prospective trials
*Experience of 1 institution. Individual results may vary, and have not been validated by a clinical trial.

As an early adopter of POCUS at Tulane Athletics, we cannot understate the importance and utility of incorporating ultrasound into athletic care. Gone are the days of taking many athletes “back to the locker room,” now that diagnostic imaging can be performed on the sideline.

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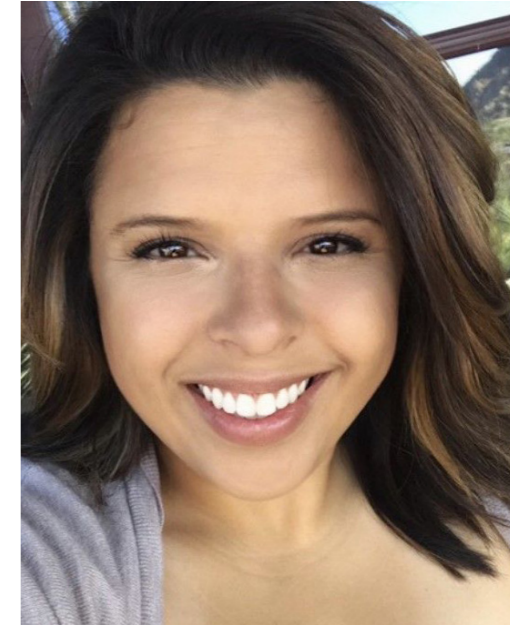
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