Jeffrey Klein, MD  Hi. This is Jeff Klein, editor of RadioGraphics and I’m pleased to welcome you to the second of our two RadioGraphics Views podcasts featuring authors from the current October 2016 Monograph issue focused on musculoskeletal imaging. This second podcast features Dr. Matthew Lee from the University of Wisconsin School of Medicine and Public Health interviewed by Dr. Kirkland Davis, chair of our musculoskeletal radiology section for the RadioGraphics editorial board and co-guest editor of the 2016 Monograph. Doctors Lee and Davis discuss Dr. Lee’s paper in the Monograph on the comprehensive sonographic evaluation of the shoulder.

Comprehensive Shoulder US Examination: A Standardized Approach with Multimodality Correlation for Common Shoulder Disease
Matthew H. Lee, MD • Scott E. Sheehan, MD • John F. Orwin, MD • Kenneth S. Lee, MD

Kirkland W. Davis, MD  Hi. I’m Kirk Davis from the University of Wisconsin musculoskeletal Radiology and one of the editors of the 2016 RadioGraphics Monograph issue.

Kenneth S. Lee, MD  Hi. I’m Kenneth Lee. I’m one of the musculoskeletal radiologists at the University of Wisconsin and the senior author of the “Comprehensive Ultrasound of the Shoulder Evaluation” article.

Matthew H. Lee, MD  Hi. My name is Matt Lee. I am currently a radiologist in the Navy but everything I’ll be talking about today is work that I did while I was a resident at the University of Wisconsin and I am the lead author on the article.

K.W.D.  Great. Okay Matt I have, Dr. Lee, a couple questions for you.

M.H.L.  Yeah.

K.W.D.  First I’m just interested in what prompted you to want to make an educational exhibit and then subsequently an article about shoulder ultrasound.

M.H.L.  Yeah, no absolutely. So I’ll start by saying that I was fortunate enough to learn MRI first and then had the opportunity to do dedicated musculoskeletal elective in my third year. I have to admit and confess that ultimately my motivation personally for doing it was that I find the shoulder really difficult and I wanted to learn more about it. So that’s kind of full disclosure on that end. Secondarily though you know I think that musculoskeletal ultrasound and particularly applications in the shoulder are really a hot topic right now. I think that there is a lot of opportunity in the field of musculoskeletal ultrasound and I really wanted to put together a really high quality educational exhibit so that I could learn more and share everything that I learned as a resident with a broader audience and I approached Ken and Scott Sheehan who is a very talented musculoskeletal radiologist at the University of Wisconsin as well as Dr. John Orwin to help out with the project.

M.H.L.  Yeah no absolutely. So really I think the things that first come to mind are its low cost, its accessibility, and really the capability of ultrasound that has really evolved in an incredible way over the last forty years you know since it was first introduced in the last 70s. So that said I think that the real time examination and the ability to interact with and talk with and examine our patients as well as capability for doing needle guidance and intervention when we use musculoskeletal ultrasound. Additional advantages in my mind I think are really patients like the examination. Providers also I think get a lot of satisfaction from interacting with patients. And then practical things like some patients prefer not to have an MRI. Some people can’t have it whether it be whether it be a pace maker or some other reason and you know we don’t fight with the same sort of artifacts that we do in MRI with arthroplasties, etc.

K.W.D.  Great. Dr. Ken Lee do you have anything to add along those lines?

K.S.L.  No I think Matt Lee is well trained at the University of Wisconsin so hopefully we hope the best for him at the Navy and starting musculoskeletal ultrasound. I agree with what Matt was saying. A lot of the advantages with shoulder ultrasound is that it can offer a quick diagnosis for a specific question. So if the question is I want to know if there’s a rotator cuff tear. Well we can do that pretty quickly. Is the pain referred to the long head biceps tendon? We can put a transducer on that area and ask where is your maximum point of tenderness and confirm that it’s indeed the long head biceps. What’s nice up on top of that, our patients really like the fact that they don’t have to take another day off of work or bring their loved ones to the clinic because we can inject the biceps tendon if the pain is there with a steroid and an anesthetic cocktail or we can inject the subacromi-
al-subdeltoid bursa with pain related to that. So it has a high specificity for that type of pain.

K.W.D. Great. So Dr. Matt Lee how about are there any areas of shoulder ultrasound where you think maybe MRI is probably a better study or where ultrasound doesn’t have the advantage there?

M.H.L. Yeah so really actually kind of piggybacking on the ideas that Ken just mentioned, really I think one of the important things when you’re considering implementing a shoulder ultrasound into your practice is really knowing the indications, right. So the things and in our article we really highlight what are the indications, when should we be using shoulder ultrasound and actually Ken touched on them. So when we’re evaluating the rotator cuff, the subacromial-subdeltoid bursa and certain indications for a long head biceps tendon and things like certainly tendon rupture and dislocation or subluxation are the ones that come to mind. But really it excels at the superficial soft tissue structures of the shoulder and so I think that knowing that and understanding limitations of ultrasound is important to implementing it in practice.

K.S.L. I think that’s a good point that Matt brings up. I think that the way we built the ultrasound practice. You know a lot of times people think it may cannibalize MRI and we didn’t want it to be a threat so the way we framed it here especially is that it’s another tool. It’s a complementary tool to MRI to help figure out what’s wrong with the patient. And there are some patients that benefit from MRI because of a large field of view. Whereas an ultrasound is a smaller field of view and answers that specific question. But to your point, things that are really good with MRI that ultrasound is not good at is just intraarticular things like the labrum for example we can’t diagnose tears on ultrasound very well. The glenohumeral cartilage, so any type of joint pathology is not very good. And bone marrow abnormalities, those are things because of the high spatial and soft tissue contrast of MRI. MR is superior to ultrasound in those regards. So again you have to know the specific advantages and disadvantages for both MRI and ultrasound when you’re considering exploring ultrasound in your practice.

K.W.D. It sounds like you have a couple of different patient populations that you see in your ultrasound practice such as one is we know we’re interested in this specific area that’s accessible to ultrasound. Another as Matt mentioned would be patients who can’t undergo MRI because of contra indications maybe they’re claustrophobic or whatever. And then are there other, I mean people wonder about you know is the ideal study for the young athlete who needs a comprehensive study. It seems like that’s not as often what you would be doing with that access right?

K.S.L. Right, that’s correct. And you know Lev Nazarian out from Thomas Jefferson University with the SRU and the gray journal collaborated on guidelines for when to use shoulder ultrasound and MRI and that’s a good reference tool and that’s something that we use as well especially in the younger patients. So folks under the age of 40 who didn’t undergo trauma, I think MRI is a better evaluation because most of the pain in the shoulder is probably referred to intraarticular things or the labrum. Whereas those who are older than that, shoulder pain may be referred to the rotator cuff more often and ultrasound is really good at that. So those are things that we can stratify our patient population and kind of you know push them into one direction or the other.

K.W.D. So do you have a feel for roughly what percentage of your shoulder advanced imaging studies are MRI versus ultrasound?

K.S.L. Well at our institution the majority of our shoulder evaluation is a form of MRI. Ultrasound is about 15 to 20 percent and that’s been growing over the last nine or ten years or so. Obviously those contra indications to MRI, the post-operative cuff for example, those who are claustrophobic you know they’ll come to ultrasound. But slowly as our sports medicine orthopedic surgeons are getting more comfortable with ultrasound, because they didn’t train with ultrasound, they trained with MRI. But as we show them the utility of ultrasound and how it benefits their patients adding value to our service, they’re starting to order more ultrasounds and rely on ultrasound before taking up a surgery. And then on the other hand we’ve kind of waited to spread ultrasound availability to the primary care physician and what we’re seeing now is more primary care physicians ordering shoulder ultrasound for their patients as well.

K.W.D. And if let’s say a primary care physician orders a shoulder ultrasound and then you diagnose a 1-cm full thickness tear to supraspinatus then do you feel like your surgeons at that point are ready to take that patient to the OR or do they usually also want an MRI to get a more global picture or are they satisfied with the ultrasound at this point?

K.S.L. That’s a good question. I would say in the beginning they would get the MRI because they didn’t trust the ultrasound. However as our relationship grew and their comfort level grew over the last few years, they are more comfortable taking patients to the OR right away based on the ultrasound diagnosis. I can’t say that was like that in the first few years, but it takes time. So when considering growing an ultrasound practice it’s not something that you would see right away.

K.W.D. I think that’s one of the many strengths of this article is seeing the images alongside each other with normal ultrasound and then an anatomic image and then a normal MRI turned so that you can appreciate that for people who are less familiar with the imaging of the rotator cuff or the other structures on ultrasound. It’s nice to be able to have those side-by-side. Now also envision if radiologists are then in the situation where they’re trying to start their ultrasound practice and sell this to their surgeons, maybe they can have those images from your article and can show their surgeons say okay when I talk about full thickness cuff tear on ul-
K.S.L. Yes. That makes sense. You know when we first kind of learned it we’re trying to fit ultrasound to the MRI parity of sagittal, coronal, axial images and so that’s how we think, that’s how we trained and when we think of ultrasound, we’re putting the shoulder in different positions internal rotation, external rotation, extension with dynamic maneuvers, it’s just a different way of looking at the same anatomy. So it’s fun to learn that, but it’s different and so as we’re trying to structure that in a more standardizing way acquiring the images, it’s a lot easier for us it kind of hold on to those images.

K.W.D. So do you feel like you’ve had – that you’re facing any incursions from your own sports medicine group to try to do ultrasound on their own? I know that in a lot of places where radiology maybe offering MSK ultrasound or radiology isn’t offering it, the sports needs are starting to do that. Have you seen that in your sports group?

K.S.L. Not yet. We’re very fortunate to be ahead of the curve in that regard. I know in some places our friends are struggling to start it because of that very reason. We’ve developed a close relationship with orthopedic surgery and sports medicine. They trust us, we trust them. They know that we’re the experts in imaging, all imaging and MSK and so they respect that boundary. So so far so good, we know that if they hired someone new who’s really interested in sports ultrasound that may be something that at that crossroad we may venture a collaboration. But right now we’re okay. We’re ahead of the curve.

K.W.D. Okay good. So Matt I know that you as you said you learned MRI of the shoulders and the extremities first in your residency and then at a time when the ultrasound rotation was still an elective you chose to do that and then you learned musculoskeletal ultrasound including shoulder ultrasound. Did you feel like it was more challenging to learn the MRI and the anatomy on MRI or was it more challenging to learn ultrasound?

M.H.L. That’s a great question. I think that they were challenging in different ways. You know I mean I think that one of my goals with writing this article was to break down some of those barriers and make this more accessible. You know I think that sometimes a musculoskeletal ultrasound can seem rather daunting if you don’t have much experience with it as I certainly didn’t as a resident, but essentially I used a framework that I already understood which was that MRI framework and then essentially tried to recreate what familiar images I knew in my mind from MRI with ultrasound and we’re talking about some of the figures that we included in this particular article and actually one of the ones that I thought was one of the most fun and fun opportunities to take advantage of was when we had some MRI time with the healthy volunteer and actually Ken and I just decided hey let’s try scanning them in the modified Crass position in the magnet which obviously we don’t advocate for, but it was really a fun tool to see what this anatomy looks like on MRI to give essentially as perfect a correlation as possible we could. So when you’re burning that supraspinatus out from underneath the acromion which is what we do in our ultrasound exams.

K.W.D. And Matt just based on your experience doing musculoskeletal ultrasound especially involving the shoulder, do you think there’s utility to, let’s say somebody comes in and the indication is assess for biceps, long head biceps tear, do you think there’s utility to sort of doing the comprehensive structured exam or do you advocate just sort of doing a focused exam of the shoulder?

M.H.L. Yes so again a very good question. I do think that you know one of the advantages as Ken already mentioned is that we can answer very specific questions and so I certainly think that first and foremost I want to make sure that we’re answering the clinical question, keeping the patient at the center and also doing our best as consultants for our referring physician colleagues. That said, I think that a standardized approach to the shoulder ultrasound examination is really essential and I think that sort of coherent reproducibility is important for the quality of your practice but also on just it helps ultimately with patient throughput and again because of the fact that certain diseases affecting the shoulder could be referred to different areas, I think that because the shoulder ultrasound is great for superficial soft tissue structures, that using that standardized examination certainly early on is really important.

K.S.L. So to add to Dr. Lee’s points, shoulder ultrasound is the most common diagnostic ultrasound indication in MSK that we see and it’s the most difficult. And so having a standardized approach is very important. Not just learning from a radiologist standpoint but your sonographer’s standpoint as well as your provider’s standpoint. So when they look at the images on their own as they pull it up with their patients, they want to see that the biceps comes first and that acromioclavicular joint and a supraspinatus and then finally the posterior shoulder. Those are the, you know, they can rely on that. And then whenever there’s a follow-up exam you can pull them up side-by-side in the standardized approach and follow it that way. So from a comprehensive standardized approach standpoint, the shoulder especially is very important to have that standard approach.

K.W.D. And so when you speak of having your technologists it’s really good for them as well to kind of do the comprehensive standard exam every time that way they’re not going to miss things, they can show us the images pretty straightforward to go through. So regarding your technologists, what was the process like training technologists to do MSK ultrasound and specifically the shoulder? What were the sort of the nuts and bolts of that process because you started with a bunch of techs who weren’t trained in musculoskeletal?
your practice in my opinion. They're an essential part of the team for MSK ultrasound and patient satisfaction and throughput and that standardized approach. I think those who have a good handle on musculoskeletal anatomy so they went to x-ray school for example and they know what a glenohumeral joint is, the learning curve is not as bad. Whereas those who are graduating now they may not have that x-ray background so the learning curve is steeper and it takes a longer time. I would say on average for us we do a quite extensive on-boarding experience for our sonographers when they want to acquire MSK knowledge and be in our pool of MSK sonographers. It takes on average 6 – 8 months for them to get used to all the different exams, especially the comprehensive exam of the shoulder and be comfortable with the diagnosis and what they’re seeing.

**K.W.D.** And so it sounds like when they’re doing that they’re working as apprentices alongside skilled already trained musculoskeletal sonographers.

**K.S.L.** Yes. Once you have that one, it’s easier to train a second one; must easier to train a third and fourth one. But then what you really need is volume and so it’s kind of a catch 22. You need the volume in MSK ultrasound to train folks in MSK ultrasound. So that’s where some of that struggle lies in starting up practice.

**K.W.D.** So if you have a diagnostic shoulder ultrasound and you have a trained musculoskeletal sonographer and he or she brings you the images and you take a look and you feel like those are satisfactory, you feel like, I mean because I know that all of us would be happy with a kidney ultrasound with not even going into the room and sort of passing that. Are you happy passing that for the technologists that you feel are fully up to speed?

**K.S.L.** You know I think in general because shoulder ultrasounds are pretty difficult. Even I’m learning something like new every day on shoulder ultrasound. I mean it’s been 15 years we’ve been doing this and I like to go in and check the supraspinateous tendon the intraspinateous tendon, ask where the patient’s maximal pain is and make sure we’re doing a thorough exam. However, with that being said, I don’t repeat the entire exam. So a sonographer may take 20 to 25 minutes to acquire the images, I’ll check the images and we’ll go into maybe you know 20 seconds of scanning and maybe a longer time talking to the patient.

**K.W.D.** Yeah, sure so we know that that’s our chance to have that face-to-face interaction with the patients that have plenty of questions because you found an abnormality and they expect you to know what’s next. Not what you tend to see with MRI. So I think we’re about out of time and I want to ask Dr. Matt Lee if he has any sort of advice for our readers about having recently gone through the process himself, do you have any advice for the readers about learning musculoskeletal ultrasound?

**M.H.L.** Yeah, so I think that first of all you can do it. I think that really all it is is understanding that you already know the anatomy and it’s really just kind of reorienting the way you think and understanding really like when should we be doing it and how to best perform a high quality exam and that does mean hands on time with the transducer obviously as Ken just mentioned, but you know I think that you can learn a lot from reading and you can learn a lot from listening to lectures, but ultimately I think it’s that hands on experience that really pays off.

**K.W.D.** And so Dr. Ken Lee and then would you have anything additional to add to what Matt said about you know how best to go about learning musculoskeletal ultrasound?

**K.S.L.** I agree with Matt. The best way is to get your hands on the probe and scan and scan and scan. It’s the same anatomy; it’s just looking at it differently from different angles with a smaller field of view. Real time imaging, dynamic maneuvers, those are the things that are different that we’re not used to, the static images of MRI and CT. So really scanning is the best way to learn musculoskeletal ultrasound.

**K.W.D.** Great. Alright well Matt and Ken Lee I want to thank you both very much for your time and for the great work on first the education exhibit and then the article that you produced for the Monograph issue. Thanks very much.

**M.H.L.** Thank you so much Dr. Davis. I appreciate the opportunity.