Dr. Andrea Spik...: Welcome everyone to the Arthroscopy Association's Arthroscopy Journal Podcast. I'm Dr. Andrea Spiker from the University of Wisconsin. Today I am joined by Dr. Melodie Metzger, who is an assistant professor and director of the Orthopedic Biomechanics Lab at Cedars-Sinai in Los Angeles, California. Dr. Metzger is a PhD researcher whose research focuses on orthopedic reconstructive devices and techniques. Dr. Metzger was the senior author of the article titled Comparable Torque to Failure Using The Simple Stitch versus The Figure-of-Eight Configuration for Hip Capsular Closure Following an Interportal Capsulotomy: A Cadaveric Study, which was published in the December 2022 edition of the Arthroscopy Journal. Dr. Metzger's co-authors were David Maldonado, Michael Banffy, Dave Huang, Trevor Nelson, Shrey Kanijiya, and Dheeraj Yalamanchili. Welcome Dr. Metzger, and thank you so much for joining me.

Dr. Melodie Met...: Yeah. Thank you so much for having me. It's a pleasure to be here.

Dr. Andrea Spik...: Melodie, can you tell us a little bit about your lab and research to start?

Dr. Melodie Met...: Yeah, sure. I'd love to. I've been here at Cedars-Sinai for a little over 13 years, and the lab initially started as a spine biomechanics lab. My dissertation and my background when I was in graduate school was mainly focused on researching the biomechanics of the spine. But about four years into my position at Cedars, the ortho department became an actual department. Prior to that, it was housed in the Department of Surgery. And so in that growth, we started doing a lot more research and it was like, "Can you do this knee project, and can you do this?"

So, we've grown and transitioned as a lab to take on basically all orthopedic projects. We've done everything. I often joke it's head, shoulders, knees, and toes. We've done every joint system in the body. And honestly, coming from the spine where you have a bunch of different joints stacked on top of each other, all the other joints, it's all just looking at how forces and torques and how the body reacts to those forces and torques when subjected to them. Regardless of what joint system, it's all looking at forces, and moments and angles and so on.

Dr. Andrea Spik...: That's wonderful. Now, we'll be discussing this particular project in more detail momentarily. But, can you tell us briefly about some of the other collaborative projects you've completed with orthopedic surgeons or that you are currently working on?

Dr. Melodie Met...: Yeah, absolutely. Like I said, we started as a spine biomechanics lab, and we were initially focused on doing some of the initial work on looking at intervertebral disc replacement, both lumbar and cervical disc replacement devices. We've also done a lot of animal models, looking at spinal fusion. And then, started collaborating more with our sports medicine affiliate, which includes the project that we're going to discuss today, which is the Cedars-Sinai Kerlan-Jobe Institute. And we've done a lot of projects investigating different techniques surrounding ECL reconstruction and repair, elbow UCL

reconstruction. And then, we've done several different hip projects, again, including the one that we're going to discuss today. Including ones that have looked at overresection of the femoral head during osteochondroplasty or femoral osteochondroplasty and how that affects the distracted stability of the hip. And then, we also did another interesting study with similar authors.

Dr. Maldanado and Banffy were on this as well, where we were looking at the thickness of graft when performing a circumferential laboral reconstruction, which also had really interesting results. And so, the hip projects probably started a few years ago. We've also done a lot of work with our foot and ankle team. Looking at different techniques, we won an award or asked the new investigator award, which was awarded to a previous resident who's now an attending here for looking at tendon transfer for patient with [inaudible] tooth disease. We also have our different projects with our trauma team.

And some of the more interesting work that I've been doing is looking at sex and gender differences in orthopedics. As we all know, there's not a ton of women in the field of orthopedics. So I've been involved with the Perry Initiative. We also have an article coming out in JAMA next month. I think it's due to hit the internet February 8th, where we're looking at racial and sex disparities and resident [inaudible], specifically in orthopedic surgery. So we do a lot of different projects and again, provides a lot of different opportunities to collaborate with many different orthopedic surgeons in different subspecialties.

Dr. Andrea Spik...: That's fantastic. And it sounds like you are indeed covering all the joints in the body, but also so much more of the social and super tentorial aspects. Which are important in not only orthopedic surgery, but engineering as far as underrepresentation of our surgeon cohort as well. So that is really encompassing a lot of important topics within orthopedic surgery and engineering. That's wonderful.

Dr. Melodie Met...: Yeah. Yeah, it's been a lot of fun and I mean it definitely keeps me on my toes. I think unlike some other labs that maybe have more depth in one area, I have a lot of breath, but I enjoy it and it definitely keeps me on my toes.

Dr. Andrea Spik...: So now if we can return to the paper that we're discussing today as a practicing orthopedic surgeon and hip arthroscopist. I know as do many of us, that one of the most common reasons for revision hip arthroscopy is actually residual impinging bone. And we also know that the best way to prevent this cause of revision hip surgery is to improve our visualization during femoral plasty most readily accomplished by either an interportal or T-capsulotomy. And then, as you discussed in your paper, more and more literature has really supported our complete closure of the capsule for best patient outcomes. So this study that you've published really represents a very important and timely clinical question related to how we perform a capsule closure, but really requires your expertise in biomechanical testing to obtain that answer. So can you discuss with us how your team came up with this specific question related to how we close the

capsule and then really go through a step-by-step process of how such a project comes together?

Dr. Melodie Met...: Sure. Yeah, I'd be happy to. And you're absolutely right. The [inaudible] damage that occurs to the surrounding soft tissues, is something that's been ignored for a while. I think a lot of people think that the bony congruency between the femoral head and the acetabular cup was sufficient stability. It perhaps provided sufficient stability, and we didn't really have to worry about these soft tissues. But as we learn more and more, we're really understanding that their issues with micro instability and subluxation and even dislocation and when we don't properly repair these structures. And it's interesting because as I was doing this paper with Dr. Maldonado and Dr. Banffy, I was planning a backpacking trip with a friend of mine, and she's a big backpacker, and her mom passed away. So we were planning this trip to honor her mom, and we were going to go and hike, I think it was about four to five days up in the Sierras.

And as we're planning it, we ended up having to cancel it because my friend had surgery for FAI. She had bony resection to correct some cam deformity, and she had that about 10 years ago. And the surgeon who treated her never bothered to really take care of the... To manage the capsule, and there was a lot of damage to the labrum. And she was going through... And then she had to get a second surgery to have those repaired, and she was having continual issues with it. And it was really specific to a hole that had formed in her capsule. So just really solidified how important these structures are. And when you ask specifically about how did we come up with this specific question, I really do need to give credit to my co-authors. So Dr. Stampy is fabulous to work with. He's an attending at Cedars-Sinai Kerlan-Jobe Institute.

He's always pushing the limit as how to control these things that we are worried about with micro instability. And then Dr. Maldonado was a fellow at the time who is now at I think, UC Health in Houston. And so the biomechanical design was something we already had in place. We had another project we were looking at comparing [inaudible] capsulotomy and its sub plant repair to a T-capsulotomy. So we have the design already in place, but the question about figure eight was really something that Dr. Banffy was using clinically on people who had maybe thin tissue. And so he was using this because he believed it was less likely to pull out. But he had concerns that it was this sort of actively placating the tissue was creating a closure that could potentially be too tight.

So based on the data that we have here, he's been using this on everybody. From what I understand, it's really changed his clinical practice to primarily using for his preference to primarily be the figure eight technique. So it's really been interesting to see this evolve from... Here, I have this very clear example with a friend of mine who's having issues with her hip to working with Dr. Banffy and trying to find a solution. And like I said, we've done hip projects in the lab before and then watching how it actually changes this clinical practice has been a really interesting evolution for me.

Dr. Andrea Spik...: Yeah. That is a real life example of what we do in the lab and what we can publish actually changes people's lives.

Dr. Melodie Met...: Yeah.

Dr. Andrea Spik...: When you are designing these types of studies, what do you find to be the most challenging components of creating a successful project like this one?

Dr. Melodie Met...: So the most challenging components are we're very limited with what we can control and what we can't. So for instance, when you're working in the biomechanics lab and you're primarily doing these categoric studies, you don't have the active stabilization system, which is the musculature. You're really just working with the passive stabilization. So it's important to keep that in mind as you're putting these studies together because that's a component that we have to think of when we start to apply these in real life. And the other challenge, specifically when we're looking at these hip studies is when you remove the hips from the body, it's really hard to orient it in terms of things like pelvic tilt and how the hip is situated in relation to the thigh and the rest of the body. So really having a concise way of making sure you're consistently potting and placing that specimen and each specimen in the same exact orientation is difficult, but yet really important to get good results.

Dr. Andrea Spik...: And that leads to my next question. In this study, this biomechanical model you were able to replicate as best we could, how the native hip moves. And so for example, in the study, you chose to study the external rotation as a means for failure. So can you explain for us a little bit of the thought process between how to test this in a cadaveric model and then why you chose to use the endpoints that you did?

Dr. Melodie Met...: Sure. I think anytime I do a biomechanical study like this, you really have to start by thinking about the anatomy and what role this structure that you're looking at plays in the body. So for this study, for instance, we're mainly interested in the capsule and we know that the capsule is made up of several different ligaments, and each has a slightly different role in how it provides stability for the hips. And the main ligament that we're interested is the iliofemoral ligament or the ligament of Bigelow. And that's because the integrity of that particular ligament is what is sacrificed during a standard AP capsulotomy. And this ligament lies on the anterior aspect of the hip and is primarily responsible for resisting hyperextension.

So when we want to test any sort of reconstruction or repair after having capsulotomy on this particular ligament, you want to hyperextend it until it fails. So that's why we would choose something, for instance, like hyperextension for this particular model. So the other thing you want to think about is reviewing the literature and seeing... You want your study and your data to potentially be comparable if there is any comparable data in the literature so that people can review your data and compare it to other studies who have maybe looked at T-capsulotomy or other techniques. So I think that's also something to consider

when you're putting together your study design and what sort of models you'll be using.

Dr. Andrea Spik...: Excellent. You make it sound so easy.

Dr. Melodie Met...: Yeah, well I think over time it does get easier.

Dr. Andrea Spik...: Yeah, well it definitely helps to have someone with your expertise explaining it all. So, let's discuss some of the limitations of this current model. You mentioned a few of them earlier, but can you take us through some of the inherent limitations of this cadaveric biomechanical model. And then, perhaps some of the limitations based on what you chose to investigate with this specific model versus what you chose not to investigate such as you using an interoral capsulotomy instead of say a T-capsulotomy to study?

Dr. Melodie Met...: Like any biomechanic study specific to cadaveric model, the main limitations are lack of musculature, obviously aren't able to account for any sort of biological healing. And so we're always looking at this time zero point immediately after surgery. So that's one limitation. We're not really looking at this over time. The other limitation is sample size. So these are very complicated. Each could ever take maybe an entire day or maybe you could do two a day. So you're obviously limited by sample size. They're also relatively expensive, so depending on your funding.

So part of the reason we didn't investigate the T-capsulotomy or expand the scope of the research project we were doing was really limitations related to time. The fellow's time, he was only here for his year. And then, funding and not being able to just test 15 cadavers. So we really chose to test and focus on the standard capsulotomy. And that's because I think when surgeons are performing a capsulotomy, they really want to limit the incision. And so, you're correct when we talk about the key capsulotomy providing better visibility. Future studies could be investigating T-capsulotomy between a simple future technique for figure eight. So that would be something that would maybe be a separate study.

Dr. Andrea Spik...: Great. And here maybe this is a good time to go over the conclusions of your study. So this study, the conclusions as published were that the hip capsular repair using either the four simple stitch or the two figure of eight configurations with an intraoral capsulotomy, demonstrated comparable failure torques and similar stiffness in cadaveric model. So with all the limitations that you discussed in mind, it seems that with whatever technique a surgeon prefers either the simple suture or the T-capsulotomy that there is no significant benefit to one over the other. So that surgeons should continue to choose what they are both most adept at. So given the conclusions of this study, what are some of the ways that you think we can answer other remaining questions we may have related to the hip capsule? So thinking back to your friend who had this failure in her hip capsule after a hip arthroscopy, have you thought about different biomechanical models that we can create to study this?

Dr. Melodie Met...: Yeah, it's really difficult with soft tissue especially to look at different models other than using a categoric model just because we are bipedal and we are one of the few animals out there that are bipedal. So coming up with a different model is certainly difficult. But I think continuing to ask questions specific to capsulotomy and focusing on perhaps long-term clinical studies to see these differences and how they [inaudible] in the human body for longer periods of time will really answer the question as to how they're both over time and with cyclic loading or repetitive motion. Which is something that we can replicate in the lab to a certain extent, but 5, 10 years out would be interesting to see how these different techniques are.

Dr. Andrea Spik...: Excellent. Now as we wrap up here, what advice do you have for our listeners who would like to study clinical questions such as the one here that you and your authors posed with biomechanical or cadaveric models?

Dr. Melodie Met...: Gosh, come visit my lab.

Dr. Andrea Spik...: [inaudible].

Dr. Melodie Met...: Yeah, I mean I'm very fortunate to work with many well-respected orthopedic surgeons who are, I would say always pushing the field to the next level. So we're constantly looking at new studies. But the relationship between orthopedic surgeons and biomechanists like myself is really a symbiotic relationship because a good clinical question won't go far without a solid study design. And I think in order to get a solid studies design, it's important to work with somebody who's familiar with putting a hypothesis and specific games together and having a proper statistical design so that you can really provide a meaningful answer to your clinical question. And then likewise, a solid study design means nothing if you don't have a clinically relevant question that is really going to be important and change the direction of the field. So like I said, it's a symbiotic relationship where we work together. And so if you want to do... If you have a clinical question, you want to look at it in a biomechanical model, I would say to pair up with a biomechanist and kind of map out how you would analyze that in the lab.

Dr. Andrea Spik...: And I think one component of your collaboration with surgeons that may not be immediately apparent is the fact that you do work across various subspecialties in orthopedic surgery as you know the field of orthopedic surgery is getting more and more subspecialized. So for example, in my practice, I no longer do any hand or foot and ankle surgery. And so, you having that cross collaboration across all of these different subspecialties, I bet is ripe for cross pollination between these various joints across the body.

Dr. Melodie Met...: Yeah, yeah, it's true. And I think having an understanding how one system works helps you better understand or be able to step out of the box a little bit and look at things differently for a different joint system. I think sometimes when people get really focused and narrowed about only analyzing the hip or the knee, you might miss the bigger picture. So I think it's important to keep a wider

field of view so that you can capture things that might not be in your immediate focus if you were too specific to one area.

Dr. Andrea Spik...: Well stated. Well, thank you so much, Melody, for joining us today.

Dr. Melodie Met...: Thank you, Andrea. It was really a pleasure to be here. Thank you so much for having me.

Dr. Andrea Spik...: Dr. Metzger's article titled Comparable Torque to Failure Using The Simple Stitch versus The Figure-of-Eight Configuration for Hip Capsular Closure Following an Interportal Capsulotomy: A Cadaveric Study can be found online@www.arthroscopyjournal.org. This concludes our episode of the Arthroscopy Journal podcast. Thank you for joining us. The views expressed in this podcast do not necessarily represent the views of the Arthroscopy Association or the Arthroscopy Journal.