Department of

BIOENGINEERING

Clemson® University

Educating Thinkers, Leaders and Entrepreneurs

From Drafts to Innovations

BIOE NEWS

Winter 2025

Delphine Dean, Chair,
Department of Bioengineering

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editorial illustrations and
magazine design, editor

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Happy Holidays!

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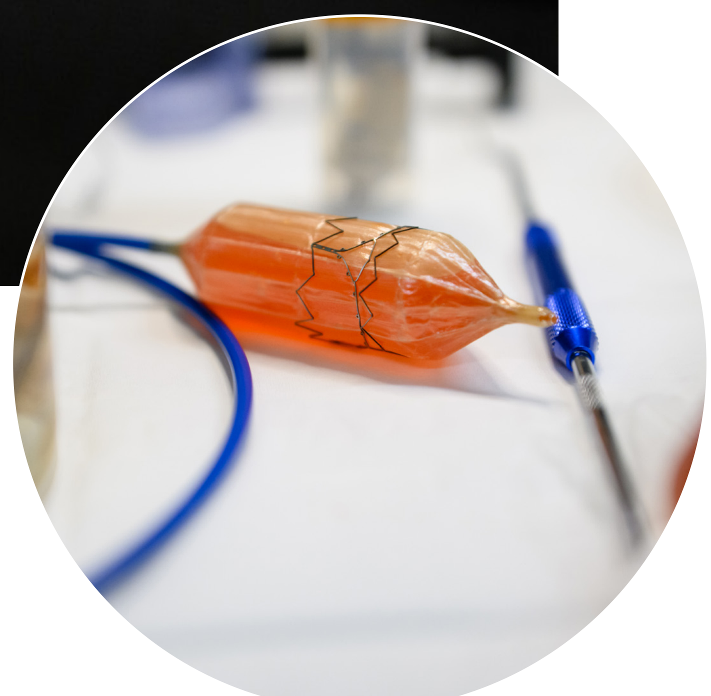
IN PURSUIT OF LIFE-SAVING DEVICE FOR NEWBORNS

Clemson News | Paul Alongi

Dan Simionescu (center) shows Susan and Jason Smith the device researchers have created with the help of seed funding from the Emerson Rose Heart Foundation. Simionescu is collaborating on the research with his former student, Lee Sierad.

A team led by bioengineering alumnus Lee Sierad is developing a heart valve that could be expanded as the child grows.

Susan and Jason Smith were in a Clemson University bioengineering lab as they leaned in to take a closer look at a wire-frame stent that researchers are developing to help save the lives of children born with heart defects.



While the stent is in the early stages of development, it is providing hope that families in the future won't have to go through what the Smiths did. Their first daughter, Emerson Rose, clung to life for 76 days in 2011 before succumbing to hypoplastic left heart syndrome, a complex congenital heart defect.

"You are making a difference in the lives of people who are not even born yet," Susan said to the students huddled around her. "That's what keeps us going."

The seed funding provided through the nonprofit the Smiths founded, the Emerson Rose Heart Foundation, kicked off a series of research projects that led to the stent and underscores the power of philanthropy and collaboration.

Emerson Rose's life inspired the creation of the Emerson Rose Heart Foundation, which helped launch Clemson University research aimed at developing a life-saving expandable heart valve for newborns.

The stent would be part of a heart valve implanted just weeks after birth and could be expanded as the heart grows, offering the chance to replace multiple surgeries with a single operation.

Leading the research from the beginning has been Lee Sierad, who holds a Master of Science and Ph.D. in bioengineering from Clemson and now works in the private sector in San Diego. He has been collaborating closely with his friend and former advisor Dan Simionescu, the Harriet and Jerry Dempsey Professor of Bioengineering.

Sierad said his work on the project has been an extension of his interest in heart valves, a passion he can trace back to his undergraduate years and through his work at Clemson with bioreactors and tissue engineering.

"Another big factor has been my spiritual walk," Sierad said. "Thinking about kids with heart valve defects, I'm glad that we have some treatments now, but they are still so hard on the families. I want to alleviate pain. I want to serve them. I want to be able to provide something so they can go home and just enjoy life and ultimately have opportunities to meet Jesus."

Growing hearts

Simionescu said the research strikes at a key challenge in pediatric medicine.

"What we do now is take adult devices and make them smaller," Simionescu said. "That's not enough. Hopefully somebody listens to this message. When children are born with heart defects, you need to implant something that will grow, because the child's heart will double in size in about 20 years."

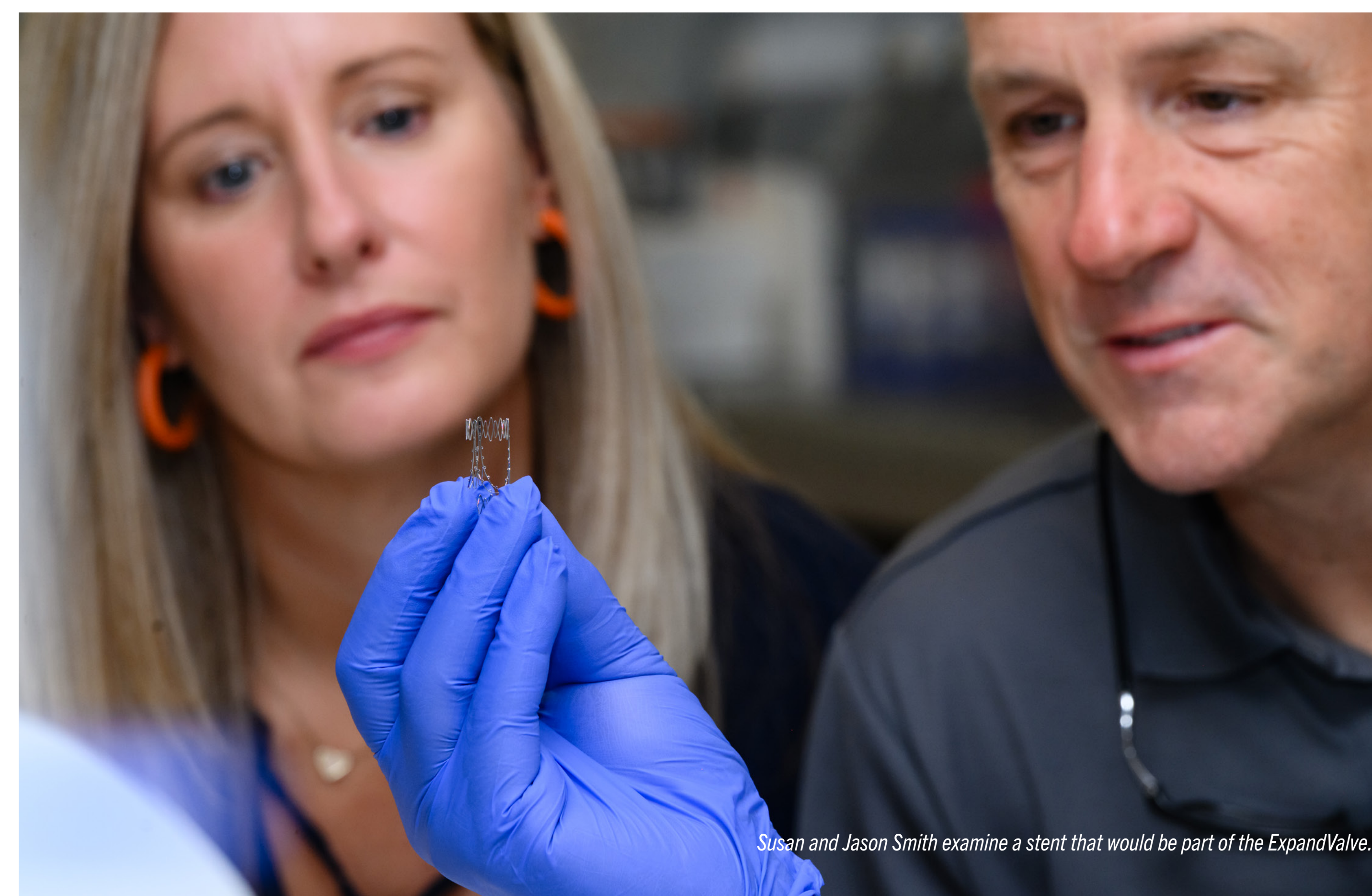
Current options force families into grim trade-offs, including multiple open-heart surgeries, oversized implants or years of waiting until an adult valve can fit.

The team's device, the *ExpandValve*, takes a different path. Surgeons would stitch thin sheets of specially processed bovine tissue into the stent. The tissue is biocompatible with humans and remarkably stretchy, capable of doubling in size without losing function.

The valve would be initially implanted through surgery. As the child grows, cardiologists would guide a balloon catheter through a vein, inflate it and expand the valve, with no major surgery required.

The process could be repeated several times, expanding from a 12-millimeter infant valve to a 24-millimeter adult valve, offering the possibility of one surgery for a lifetime of function.

Lee Sierad has led research that could one day save the lives of children born with congenital heart defects.



Susan and Jason Smith examine a stent that would be part of the ExpandValve.

▲ *Dr. Minoo N. Kavarana, who was Emerson Rose's surgeon, has been a key partner in the development of the ExpandValve.*

Building the team

Moving that possibility closer to reality has been a long journey.

Sierad was nearing the end of his Ph.D. studies in 2013 when he founded Aptus Bioreactors to commercialize his research. He sold heart valve and vascular bioreactors around the world while continuing to work with Simionescu to seek funding for heart valve research.

Sierad said a friend from church was on the board of the Emerson Rose Heart Foundation and connected him with the Smiths. The $25,000 in seed funding the foundation provided in 2020 allowed Sierad to begin investigating what it would take to build a heart valve for children and to start designing one.

"Would it look like a metal stent that expands?" he remembered asking at the beginning of the project. "Would it look like a degradable stent that deteriorates as the child gets larger? Should we target a 1-month-old, 1-year-old, or 10-year-old?"

That work set the stage for Sierad to secure a $252,000 small-business grant from the National Institutes of Health (NIH) in 2021, allowing him to hire someone to design and manufacture a stent.

This year, the NIH approved an additional $322,000, setting the stage for more advanced testing led by Dr. Minoo N. Kavarana, who was Emerson Rose's surgeon and now serves as Division Chief, Pediatric and Adult Congenital Cardiothoracic Surgery, at the Medical University of South Carolina (MUSC).

> "I'm excited to be working alongside Lee and Dan to help bring this device closer to the children who need it most," he said. "What makes this project especially meaningful is the Smiths' vision and generosity, turning their family's heartbreak into hope for countless others. That spirit is what drives us forward."

**See notes section at the bottom for collaborator list.*

'She looked perfect'

Delphine Dean, chair of Clemson's Department of Bioengineering, said the ExpandValve underscores the power of collaboration to address real-world needs.

"The ExpandValve reflects the best of Clemson bioengineering—innovation with purpose, collaboration across organizations, ongoing relationships between professors and alumni and a commitment to improving lives," she said. "Projects like this show how our work today can change what's possible for generations to come."

The work also serves as an example of how deep Clemson Family roots can run. The Smiths live minutes from campus, and Susan holds a bachelor's degree in secondary education and a master's degree in counselor education, both from Clemson. She worked as an academic advisor in General Engineering at Clemson before Emerson Rose's birth.

After touring Simionescu's lab, Susan and Jason sat in his office and remembered the time they had with their daughter, who was born on April 11, 2011. Susan recalled looking at Emerson Rose, rubbing her leg and holding her hand.

She underwent surgery at MUSC at just 4 days old, the Smiths said.

"If you had removed the support that she had, she looked perfect, didn't she?" Jason asked.

"You wouldn't have known anything was wrong with her," said Susan, who recalled feeling pure joy.

▲ *A large team has been involved in developing the ExpandValve.*

Sharing their faith

While Emerson Rose was treated in the pediatric ICU, the Smiths felt the urge to do something to help others struggling with congenital heart defects in children. Their desire only increased after she passed away, they said.

Since then, the Emerson Rose Heart Foundation has raised millions of dollars that have helped fund research, share the Smiths' Christian faith, raise awareness and provide spiritual, emotional and financial care to families. The Smiths also advocated for the Emerson Rose Act, a 2013 state law that requires all newborns to be screened for congenital heart defects at birth.

Last year alone, 60,000 newborns were screened, the Smiths said.

Susan said it is exciting to think that the heart valve research the foundation helped start could one day result in a device that is implanted in children.

"What touches me most is the connection between two places I love, Clemson University and MUSC, with Dr. Kavarana," she said. "This is just incredible. It touches my heart." ■

Additional notes: Throughout the years, numerous consultants, students and other collaborators have participated in this project: Sam Pashneh-Tala, design engineer; Aggie Simionescu, tissue engineer; and Clemson bioengineering graduate students Erica Hoskins, Martin Lautenschlager, David Podolsky, Josh Wingold and Annelise Pagan.

Expandable heart valve designed to grow with children

Clemson News | Paul Alongi

The ExpandValve can be balloon-expanded as needed through a minimally invasive procedure, allowing it to increase in size as the child grows.

▲ *The ExpandValve is is an off-the-shelf surgical valve designed specifically for infants.*

Current adult-sized artificial heart valves (whether mechanical or bioprosthetic) are fixed in size, unable to expand as a child grows, and therefore unsuitable for babies.

The Expand Valve™ aims to change that. The patent-pending device is an off-the-shelf surgical valve designed specifically for infants.

The device features three highly elastic valve tissue leaflets sutured onto a novel expandable stent. The valve can be balloon-expanded as needed through a minimally invasive procedure, allowing it to increase in size as the child grows.

That stent — a very thin, laser-cut, medical-grade metal frame — is radiopaque, allowing easy visualization and size verification as the child grows. It also includes innovative design elements for streamlined manufacturing, optimal valve performance and precise implantation.

The valve leaflets are made from biocompatible, decellularized biological tissue that can stretch up to 100% without compromising hemodynamics. They are also chemically stabilized and treated with anti-calcification agents to ensure long-term durability.

Unlike other pediatric valves made from non-stretching tissue, the opening of the Expand Valve™ depends on both the stent design and the elasticity of its tissue leaflets. ■

Bioengineering professor enhances national renown with award named for Clemson University

Clemson News | Paul Alongi

> *Jeremy Gilbert is starting the fall semester with a growing reputation as one of the top researchers and mentors in his field.*

A Clemson University bioengineering professor who specializes in making metal implants such as hips and knees last longer in the body is starting the fall semester with a growing reputation as one of the top researchers and mentors in his field.

Jeremy Gilbert serves as the Hansjörg Wyss Endowed Chair for Regenerative Medicine and the director of the Clemson-MUSC Bioengineering Program.

This year, the Society for Biomaterials awarded Gilbert the Clemson Award for Contributions to the Literature. The award's name reflects the strong ties between the society and Clemson's pioneering bioengineering program dating to 1974.

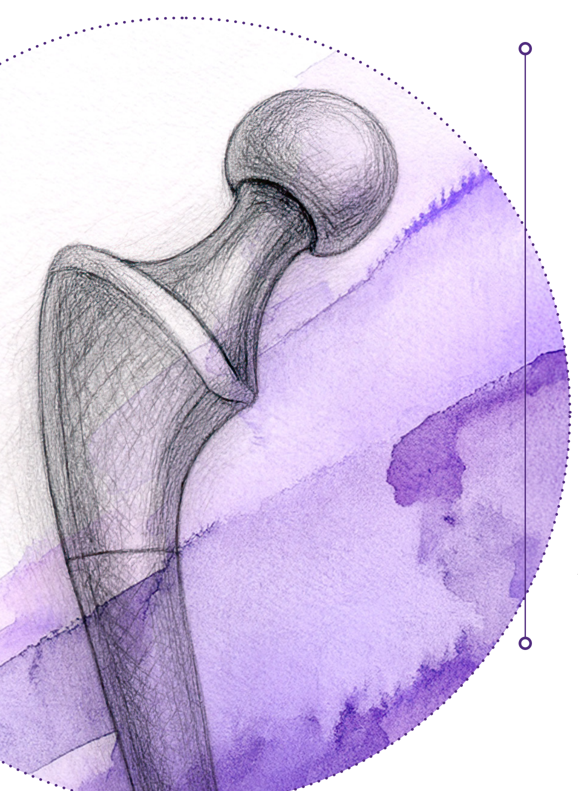
Gilbert's win marks the first time a Clemson professor has held the honor since 1991, when it went to Andreas F. von Recum.

"It's a wonderful award," Gilbert said. "The absolute leaders in the field over the last 50 years have been proud to receive the Clemson award, and here I am as a Clemson professor, winning the Clemson award."

Gilbert's work with metal implants starts with a bit of forensic analysis, almost as if he were a detective.

He and his students take the metal implants that have failed while inside of patients' bodies and investigate them. They ask whether the implants broke, corroded or wore out, then try to create tests that simulate the degradation.


Jeremy Gilbert



"Once we have that, now we can help," Gilbert said. "We can work with the manufacturers to look at alternative materials, to change designs. Then you get more insight over time. You learn from the patient, you go back to the lab, you study it, you propose alternative designs and alternative materials, and sometimes you discover things that you would never expect."

Joshua Jacobs, an orthopedic surgeon at Rush University Medical Center who has collaborated with Gilbert, said he stands out for the breadth and depth of his metallurgy knowledge, particularly electrochemistry-related research, along with his ability to communicate it to physicians. He is also an excellent educator, Jacobs said.

"He really works well with students, and I think that's another reason for his success," Jacobs said. "He has an entourage of people that he's trained and have had a tremendous impact on the field."

Among them is Mark Ehrensberger, who worked with Gilbert while pursuing a Ph.D. at Syracuse University and is now an associate professor of biomedical engineering at the University of Buffalo.

"From a student perspective, he gave you the freedom to explore in the lab and have independence," Ehrensberger said. "But he was also a very good mentor, and I remember countless times sitting in his office, and he would get out a piece of paper, and he'd start sketching out the ideas or the fundamental principles of what we really needed to understand. I still have some of those pieces of paper with his handwritten notes on it."

Metal implants face a barrage of challenges inside the body. It's a salty environment so they oxidize and corrode. If bacteria forms colonies on implants, they have to be removed and treated with antibiotics and put back in. Many implants, such as knees, have to support a full body's weight thousands of times a day.

On top of that, the body's natural reaction is to attack artificial materials inside it.

Another challenge is that patients are getting metal implants at younger ages, often in their 50s when they still want to golf, bike and find other ways to stay active, Gilbert said.

"You've created a demand and an environment that's much more severe than, say, an 80-year-old person who might not be very active getting these devices," he said. "You're trying to design the materials so that they can withstand 20, 30 years in the body. You want to reduce corrosion or wear enough that it will last for a long, long time. And that's really the focus of the work that I do."

Gilbert is staying up on the latest cutting-edge techniques, including research into a process called tribocorrosion. Rubbing metal implants, such as those made of titanium, can briefly destroy the ultra-thin protective oxide layer that keeps them from corroding.

Gilbert and his team use atomic-force microscopes with a sharp diamond tip to scratch surfaces smaller than a single atom and watch in real time how that protective film breaks down and repairs itself inside the body.

In addition to his Clemson award, Gilbert is set to collect the Clifford C. Furnas Memorial Award for Contributions to the Natural Sciences and Mathematics from his undergraduate alma mater, the University of Buffalo.

Yet as Gilbert looks to the future, he's focused less on the accolades and more on the people.

"What I'm loving doing is making connections to the next generation of scientists, getting them excited about ideas, and then working with them to promote their ideas– to move them forward," he said.

Delphine Dean, chair of the Department of Bioengineering at Clemson, said Gilbert's impact goes beyond his research.

"He's a leader in biomaterials, inspiring a new generation of bioengineers to push boundaries, solve real-world problems, and carry Clemson's legacy of innovation into the future," Dr. Dean said. "He exemplifies the best of what it means to be a mentor and colleague." ■

JESSICA LARSEN

of Clemson University lands nearly $4 million in NIH grants, including elite New Innovator Award

Clemson News | Paul Alongi

The funding solidifies Larsen's status as one of the nation's leading early-career investigators.

Jessica Larsen works in her Clemson University lab.

Jessica Larsen of Clemson University has secured nearly $4 million from the National Institutes of Health to launch two separate research projects, including one funded by the highly prestigious and competitive NIH Director's New Innovator Award.

The awards solidify Larsen's status as one of the nation's leading early-career investigators. A member of Clemson's faculty for eight years, she serves as the Carol and John Cromer '63 Family Endowed Associate Professor of Chemical and Biomolecular Engineering.

The $2.3-million New Innovator grant funds research into developing nanoparticles that can sneak RNA medicines past the brain's defenses to treat diseases ranging from Alzheimer's to cancer.

The other grant, a $1.67-million R01, focuses on slipping therapies past the body's protective blood-nerve barrier to help patients recover from painful and debilitating nerve injuries.

"Dr. Larsen's outstanding achievements reflect the growing impact that Clemson University is having on global health innovation," Clemson President Jim Clements said. "Our faculty are committed to excellence and to transforming lives through the power of research. They are asking big questions, pushing the boundaries of what we think is possible and as Dr. Larsen's most recent NIH awards highlight – our faculty are shaping the future."

Larsen said the grants show persistence pays off.

> "As we all know, research can ebb and flow," she said. "Sometimes things work, and sometimes they don't, but by continuing to plug along with your same vision over time, efforts start to pay off."

Larsen, the Carol and John Cromer '63 Family Endowed Associate Professor, for a photo in front of the new Advanced Materials Innovation Complex.

New Innovator Award

NIH's New Innovator Award backs high-risk, high-reward research. Larsen's project tackles two problems at once: how to make RNA treatments last longer in the body, and how to get them past the blood-brain barrier.

Her team is creating nanoparticles– akin to tiny, benign Trojan horses– that would slip RNA into the brain. Inside these particles would be tiny droplets called coacervates that protect RNA.

The droplets would stay sealed until they sense signs of distress in the body, such as the chemical stress that shows up in many diseases. When those signals appear, the droplets would break apart and release the RNA.

Once released, the RNA would help cells make proteins to fight disease, including Parkinson's and childhood neurodegenerative conditions.

R01 Grant

For the R01 grant, Larsen is teaming with Professor Jeff Twiss of the University of South Carolina to regenerate nerves after injury. Twiss developed a therapy that showed strong promise but could only be delivered through surgery.

Larsen's group is working to engineer nanoparticles that can slip past the body's protective blood-nerve barrier and carry the treatment directly into nerves.

The goal is to turn what now requires surgery into a simple injection, a shift that could speed recovery and improve outcomes for people suffering from painful and debilitating nerve injuries.

Jessica Larsen, right, and Ph.D. student Seoyoung Lee work in their Clemson University lab.

Praise from Clemson leadership

David Bruce, chair of the Department of Chemical and Biomolecular Engineering at Clemson, said the two grants are a testament to Larsen's hard work and creativity.

"Dr. Larsen is not only pushing the boundaries of knowledge but also elevating Clemson's reputation as a hub for innovation," Bruce said. "These awards are well deserved, and she is well positioned to lead both."

Among those offering their congratulations was Anand Gramopadhye, dean of the College of Engineering, Computing and Applied Sciences.

"These recognitions from NIH place Dr. Larsen among the nation's most innovative researchers," Gramopadhye said. "Her work underscores Clemson's role as a leader in health innovation and shows the power of persistence, teamwork and bold ideas."

The New Innovator Award is associated with project number 1DP2NS148060-01, and the R01 is associated with project number 1R01NS142877-01. ■

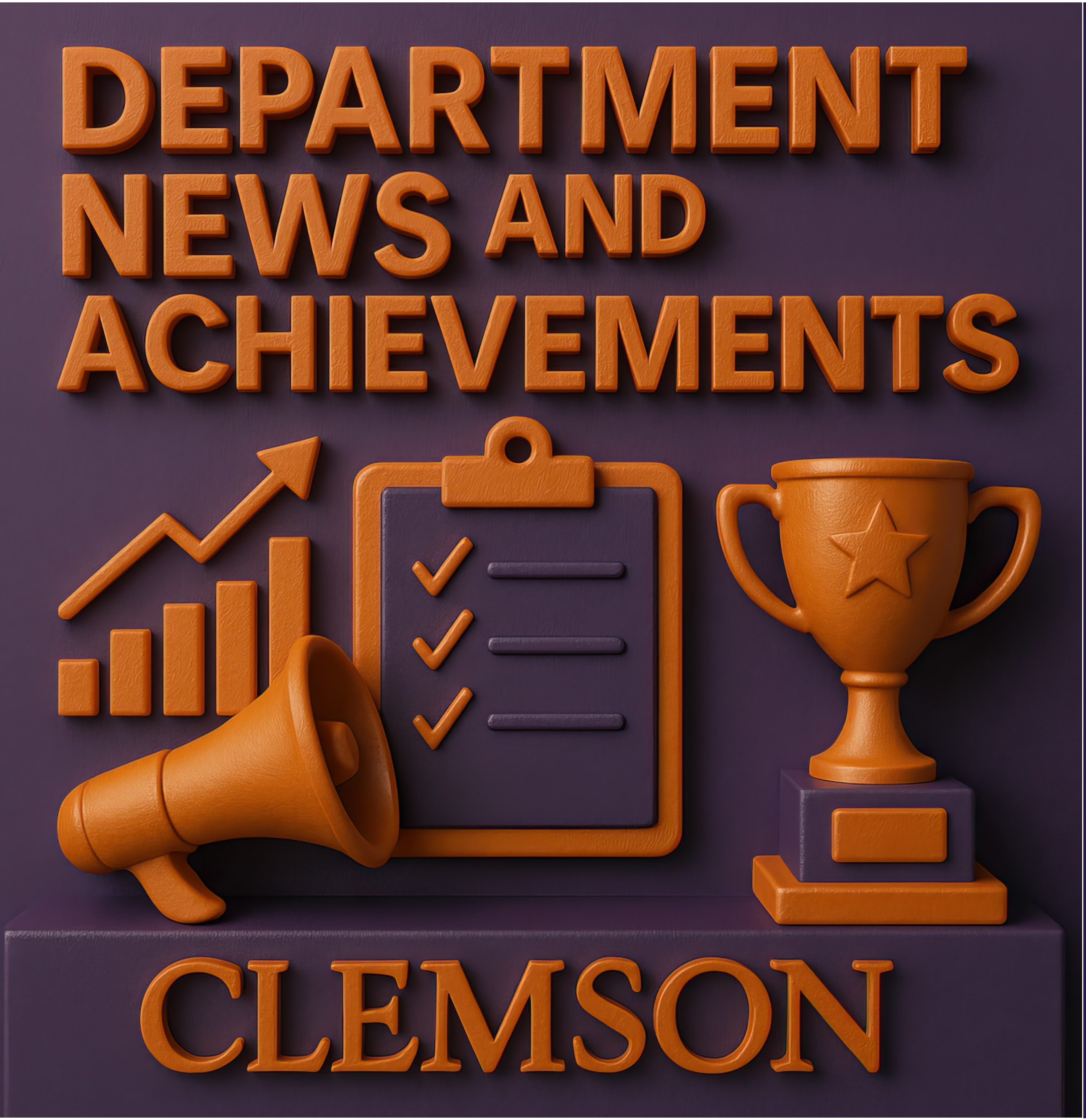
Faculty Promotion

At the beginning of the Fall semester, the University announced the tenure and promotion at Bioengineering department.

David Karig | Professor

Yongren Wu | Associate Professor

Tong Ye | Professor



DEPARTMENT

DEPARTMENT NEWS AND ACHIEVEMENTS

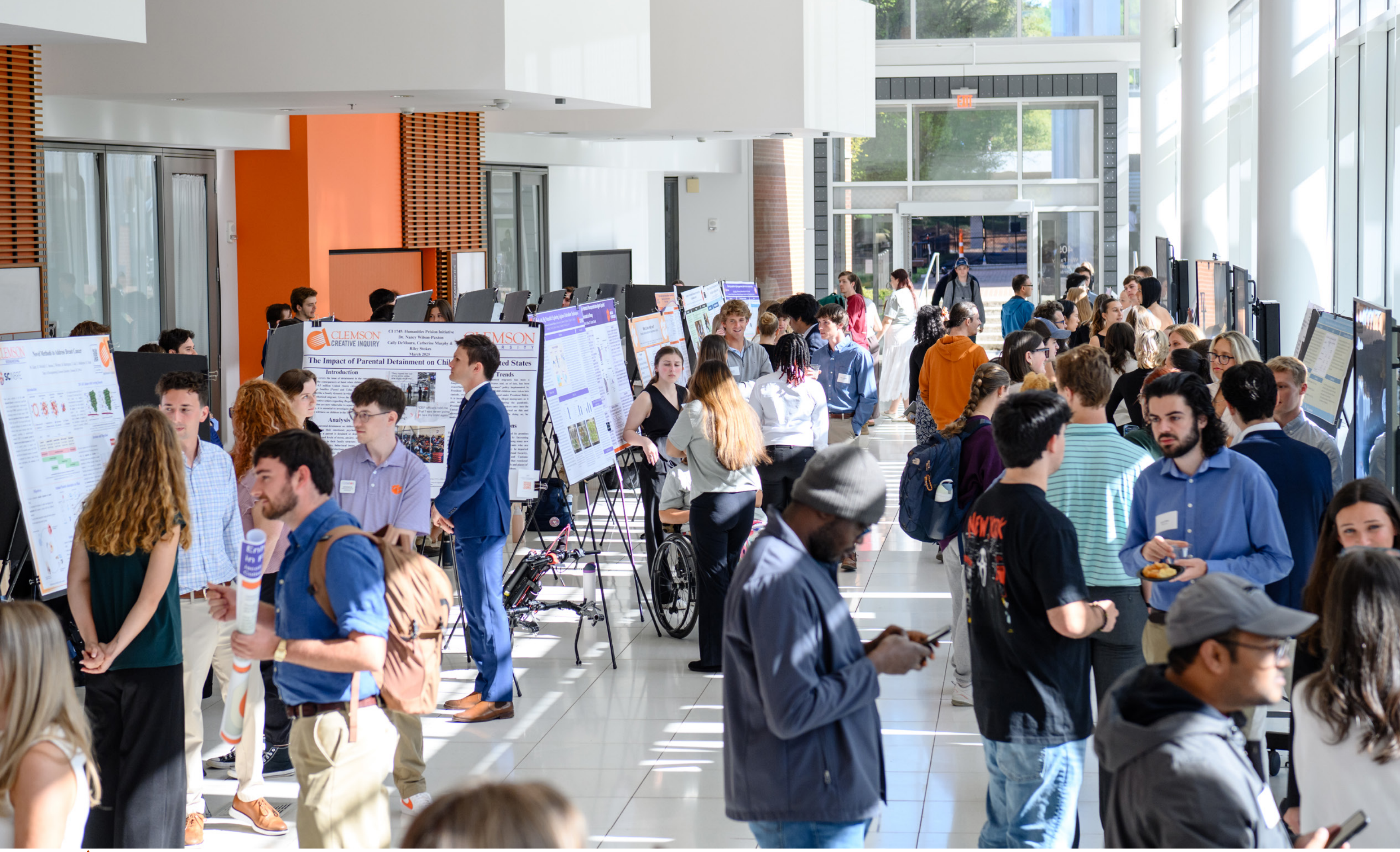
NEWS AND ACHIEVEMENTS

DELPHINE DEAN:

EMBRACING CREATIVE INQUIRY FROM THE START

Clemson News | Angela Nixon

Delphine Dean, Ron and Jane Lindsay Family Innovation Professor and Professor of bioengineering



Delphine Dean joined the Clemson faculty in 2005, the same year that the Creative Inquiry (CI) program started. So it shouldn't be surprising that she was an early adopter of CI and that she has continued to be one of the most active faculty mentors in the program

Dean is the Ron and Jane Lindsay Family Innovation Professor and chair of the Department of Bioengineering. She has mentored more than 30 projects over the past 20 years, many of which have had a global impact. She said in her experience, there are really two types of CI projects — those that are developed by faculty members who want to collaborate with colleagues in other disciplines to try something new and those that are initiated by students.

In one of her earliest CI projects, students in an instrumentation and imaging class she taught wanted to continue to work on a project to develop a low-cost neonatal incubator that they had started in her class. Around the same time, she got a call from a colleague at the Medical University of South Carolina that she says was "serendipitous." The colleague was taking a trip to Tanzania to conduct surgical training, and he asked Dean if any engineers might want to join the trip to help improve conditions at the neonatal ICU there.

> "I was like, 'I have some students who are interested in that!'" she said.

Dean and her students took that trip to Tanzania, which led to a partnership with Arusha Technical College and ultimately the Designing Medical Technology for the Developing World CI project. That project has been running since 2009, with students developing devices such as low-cost diabetes test kits and basket-woven neck braces for injuries.

When the world shut down in 2020 due to the COVID-19 pandemic, Dean faced the challenge of how to continue to engage her students in research from afar. Her students worked on designing a hood that doctors could use on COVID patients to protect medical staff from infection during the intubation process. Students created something out of materials they were able to access at home or at their local hardware store, such as shower curtains, PVC pipes and HEPA filters, and they recorded videos of their tests on the hood. Their designs ended up being implemented in several area healthcare facilities.

That project sparked the idea for the Clemson COVID Challenge, which took place that summer, administered in partnership with CI. Students from across disciplines worked through the summer on COVID-related research projects and held a competition to pitch their projects to faculty and industry judges. The competition was open to students from colleges and universities across the state, so its impact was felt well beyond Clemson.

> "Some of the projects that students come up with are amazing," said Dean. "They have very out-of-the-box ideas."

Dean's entire department has embraced CI. Students can use up to six credit hours of CI research towards their technical elective requirement, and she said the vast majority of their undergraduates participate in CI or some other kind of undergraduate research. Dean also said that everyone on the bioengineering faculty who are based in Clemson or Greenville are involved with CI.

"We have eight faculty members who work in Charleston, and they're very jealous," said Dean. She said the Charleston faculty do offer a Summer CI project to get students to work with them during the summer months, and some of them are involved in remote joint mentoring during the semester.

Delphine Dean works with a student in her Clemson University lab.

Other CI projects in Bioengineering

- **Engineering Nanobiomaterials for Delivery of Cancer Therapy** — Led by Angela Alexander-Bryant, associate professor of bioengineering, this project is working to develop innovative drug delivery systems to advance cancer treatment. Using micro- or nano-scaled drug delivery systems could allow for more targeted treatment directly to tumor sites and minimize harm to healthy, non-cancerous cells.
- **The REDDI Lab (Research and Education in Disease Diagnosis and Intervention)** — The REDDI Lab is Clemson's first CLIA certified laboratory, established in Fall 2020 to manage the University's COVID-19 testing during the global pandemic. Students in this CI get experience with a variety of diagnostic testing methods, data analysis techniques and professional practices within a clinical lab setting. Mentored by research assistant professor Austin Smothers and assistant professor Carolyn Banister along with Delphine Dean.
- **Remote Human Movement Analysis** — This CI looks at developing new technologies for analyzing human movement in natural settings outside of the lab or a medical office. One example is developing technology to measure gait as a way to detect Alzheimer's disease and other health issues that affect walking and movement. Mentored by assistant professor Reed Gurchiek and doctoral student Haley Hentnik.

"Bioengineering is a very interdisciplinary field, and CI is a very good mechanism for faculty to start those kinds of projects," she said. "CI lets you do things that are just hard to do if you don't have that structure in place. I think it's great for the student experience, and it feeds into the research enterprise in ways that we don't talk about as much. We've gotten preliminary data that has helped get us grants, high impact publications, win awards, all from CI projects. It definitely helps build our research capacity."

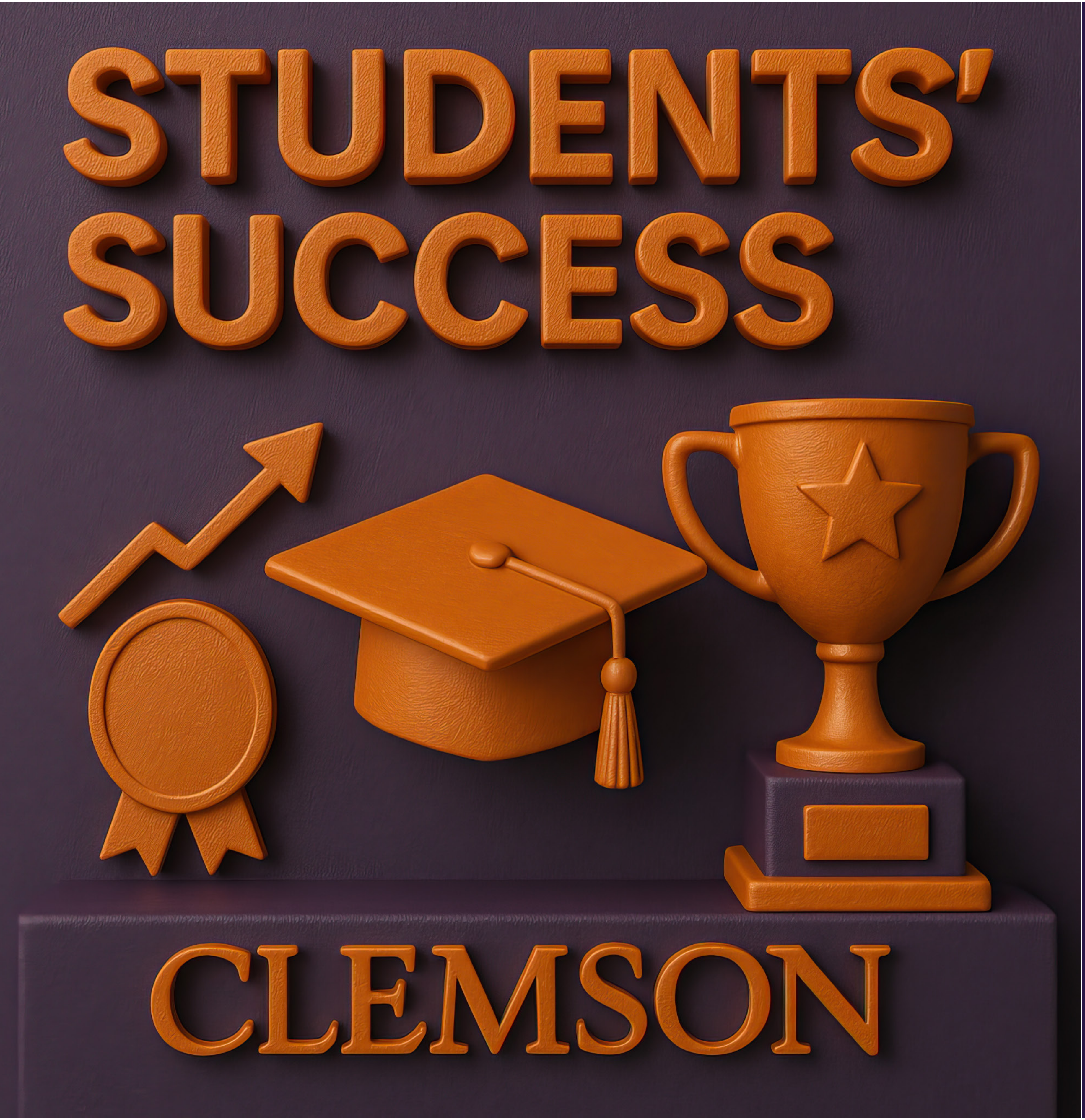
Dean said CI is something that sets Clemson apart from other universities in terms of undergraduate research and experiential learning.

> "CI is a huge selling point when you talk to students. This is an experience that they will not get at other places. Other schools do have undergraduate research, but it's a lot less student-driven. Students have a lot more intellectual ownership of these research projects."
>
> *Delphine Dean, bioengineering department chair*

She said CI is also a part of her recruitment of new faculty to come to Clemson.

"CI is part of the reason I have stayed at Clemson," she said. "I got here the year CI started, and I can see the difference it has made over the years."

This story is part of a series focused on long-standing projects and faculty mentors who have been involved with Creative Inquiry + Undergraduate Research since nearly the beginning of the program. For more information, visit clemson.edu/ci.



STUDENTS'

STUDENTS' SUCCESS

SUCCESS

ARTHRITIS DISCOVERY could lay groundwork for new diagnostics and treatment

Clemson News | Paul Alongi

Lizzie Walker, now an alumnus, was a Ph.D. student in bioengineering when she led a team of researchers that won an award for its work.

Lizzie Walker was lead researcher on a paper has earned the Athanasiou Student and Postdoc Award.

The award-winning research that Lizzie Walker did to earn her Ph.D. in bioengineering from Clemson University could be a step toward new ways of diagnosing and treating a painful form of arthritis that makes it hard to open jars, grip tools, or turn a doorknob.

Walker led a team of researchers that found the volar ligament complex (VLC) of the basal thumb joint may be the critical point for understanding osteoarthritis in that joint.

“The big picture is that this research opens the door for better diagnostics and more targeted treatments for thumb arthritis,” Walker said. “By focusing on the volar ligament complex, especially where it attaches to the metacarpal bone, we may be able to catch the disease earlier and treat it more effectively.”

Walker, who completed her Ph.D. this year, served as first author on the paper that reported the team’s findings.

The paper has earned the Athanasiou Student and Postdoc Award, a national honor that is regarded as an indicator of future leadership in biomedical engineering. Walker now works in Tampa as a biomechanics associate at the consulting firm Exponent.

For the study, researchers compared healthy and arthritic basal thumb joints from 24 female cadavers. The team tested the mechanical capabilities of three major ligaments and examined them with high-powered microscopes and other imaging techniques.

Researchers found that while other ligaments stayed intact, the VLC became weaker and began to lose its structural integrity. In advanced arthritis cases, the VLC pulled away from the metacarpal bone and lost the normal transition zone where ligament blends into mineralized bone. That made areas of the VLC near the metacarpal bone more prone to failure than the other ligaments in the joint.

That finding matters because osteoarthritis in the thumb is especially common in postmenopausal women, who undergo surgery for the condition at rates 10 to 15 times higher than men.

Current diagnosis relies mostly on X-rays that show bone changes, often missing early soft-tissue damage.

Walker said the recognition was especially meaningful after years of painstaking work, which began in 2021 and involved extensive dissection, imaging and testing.

“I’m just really thankful the time I put into this pap being recognized, along with the time my co-author in,” Walker said.

At Clemson, she studied under Yongren Wu, a co-au on the paper and an associate professor of bioengine based at the Clemson–MUSC Bioengineering Progra Charleston.

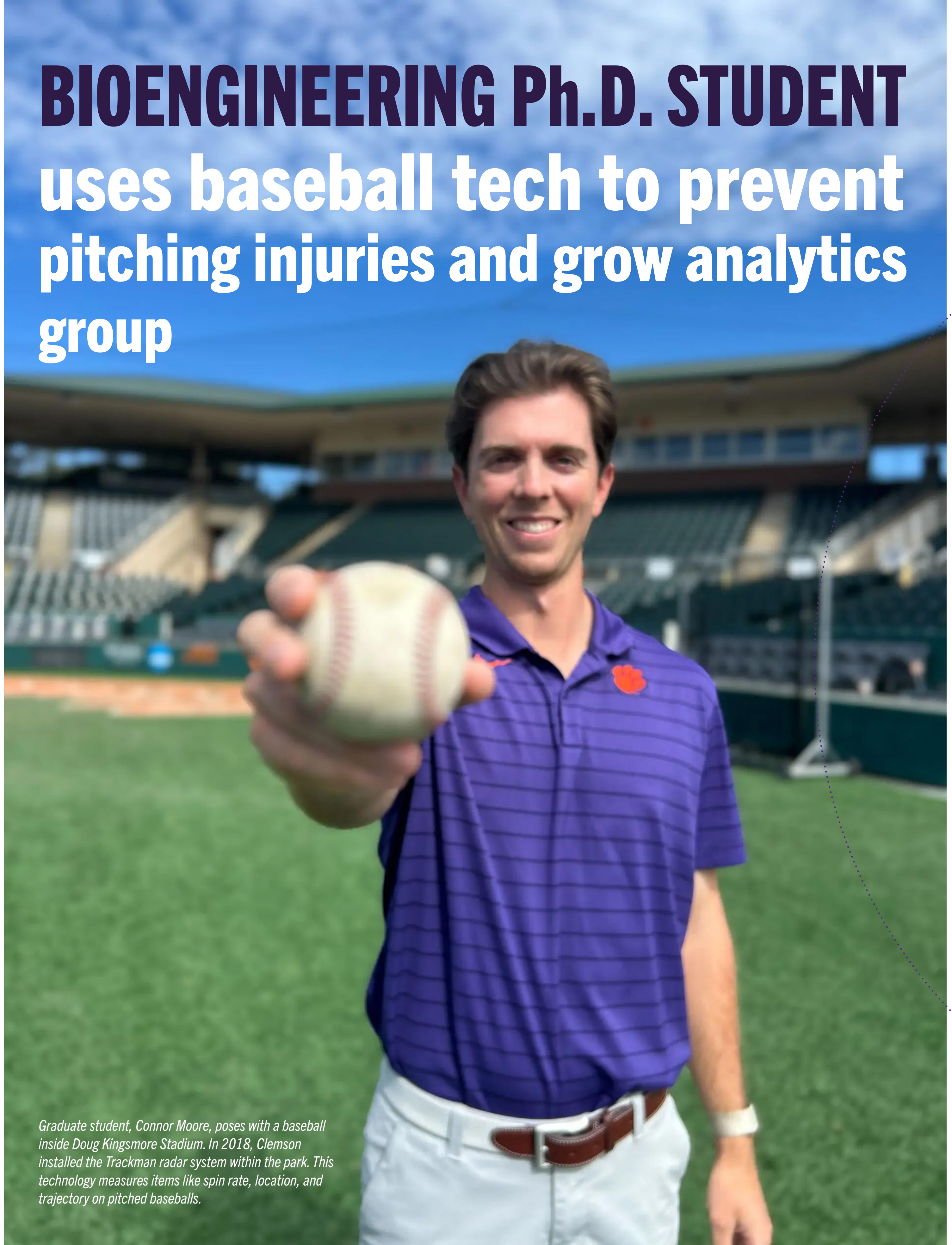
Co-authors also included Daniel Gordon and Zhaoxu M both of Clemson University; Wu, Shangping Wang, an Yao, all of Clemson University and the Medical Unive of South Carolina; Alexander Chiaramonti of Wake F University School of Medicine; Dane Daley of M Vincent D. Pellegrini Jr. of Dartmouth-Hitchcock Me Center; and Elizabeth Slate of Florida State University

The title of the paper is, “Morphological and Mecha Property Differences in Trapeziometacarpal Ligamer Healthy and Osteoarthritic Female Joints.” It was publi in the Annals of Biomedical Engineering.

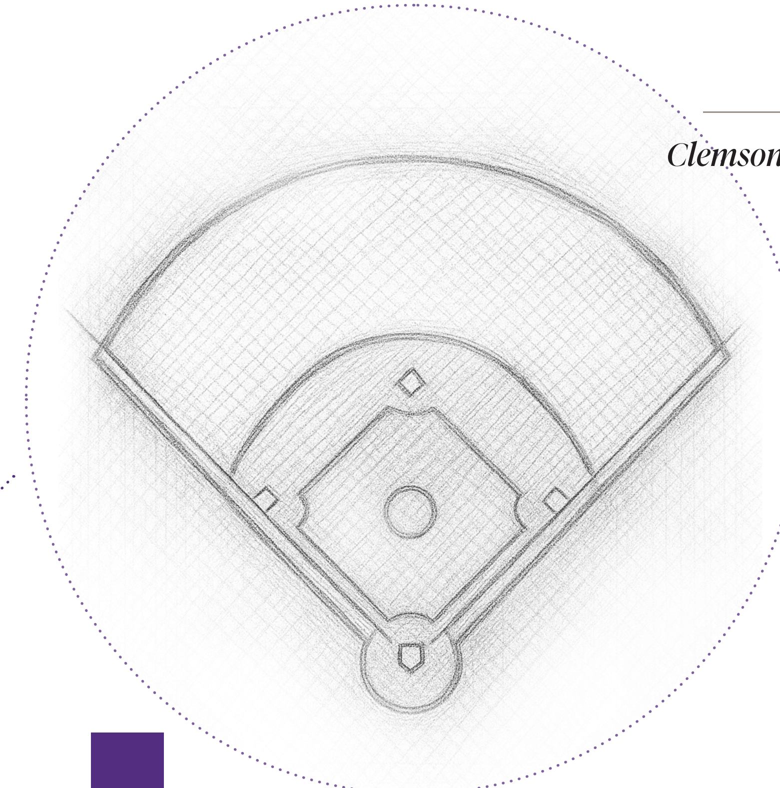
Delphine Dean, chair of the Department of Bioengine at Clemson, said the award is a testament to Wal talent and dedication.

> “This recognition puts Lizzie outstanding company,” Dean said. “It also highlights the strength of the Clemson-MUS Bioengineering Program and the impact our researchers are making in advancing musculoskeletal research. I of my congratulations to Lizzie and the team.” ■

BIOENGINEERING Ph.D. STUDENT uses baseball tech to prevent pitching injuries and grow analytics group



Graduate student, Connor Moore, poses with a baseball inside Doug Kingsmore Stadium. In 2018, Clemson installed the Trackman radar system within the park. This technology measures items like spin rate, location, and trajectory on pitched baseballs.



Clemson News | Katie Gerbasich

Baseball has evolved over the last decade to focus beyond what happens on the field of play, with over 200 stadiums installing Trackman technology to provide ball tracking data. This information allowed Department of Bioengineering graduate student Connor Moore to capitalize on the intersection of sport and biomedical engineering to develop his research on monitoring injuries at the pitch level.

> Trackman technology has allowed Connor Moore to capitalize on the intersection of sport and biomedical engineering to develop his research on monitoring injuries at the pitch level.

Defending his Ph.D. dissertation this fall, Moore's work aims to monitor workload in pitchers better than pitch counts. He explained how the industry standard is to count the number of pitches thrown concerning the risk of injury. However, this is not always the best way to prevent injuries.

"We wanted to do something better," Moore said. "It is a comprehensive look at how you use ball tracking to monitor performance, but then branching out into using it for health monitoring."

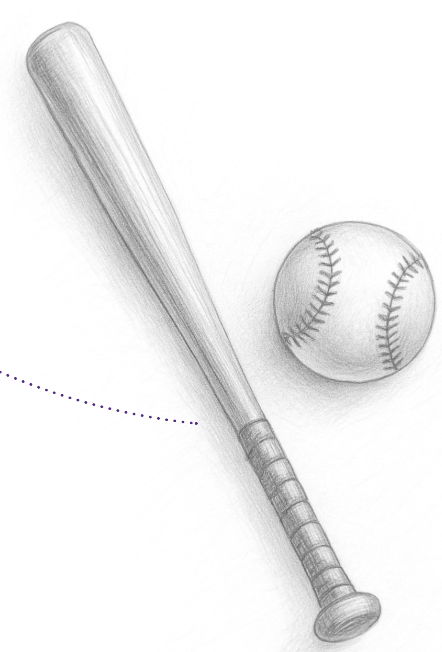
Funded by a collaboration grant from Clemson's Robert H. Brooks Sports Science Institute in 2024, Moore utilized ball tracking data to develop a machine learning model to estimate how much stress is put on an elbow when a pitch is thrown. This elbow load can be applied over a large number of pitches to assess injury risk over time in pitchers.

"There are millions of pitches that come in each year," Moore said. "So it's a big opportunity to at least address a big gap in what is a big problem in baseball."

Moore joined Clemson Olympic Sports Science as an intern in January 2022. Later that fall, he assisted in developing the Clemson Baseball Analytics group with Jason Avedesian, former director of Clemson Olympic Sports Science. What started as a small team has evolved into new graduate students taking on leadership roles to expand the breadth of the program.

"The mission was always to create that opportunity for others, like what can we do to expand what we do so that more students can come in and have opportunities," Moore said.

The analytics-driven team now consists of over 20 undergraduate students with different branches led by graduate students, working together to assist Clemson Baseball. Students in the program have interned with professional organizations like the Atlanta Braves and Houston Astros.



"Watching that turn into an entire pipeline where new students come in and bring new ideas that turn into new subgroups that invite even more students has been really cool," Moore said. "I just feel like we've done something good for the University and for students here."

One of the group's most significant accomplishments was the development of an app that allows for automated scouting reports. Previously, generating these reports would take an exceptional amount of time because the information had to be input manually.

"I think it's really cool because the only reason that was possible was because we put students in a position to lead that," Moore said. "Jason and I may have thought of it with a lot more time, but we couldn't have implemented it. So it was a good reflection on how we built the group and what we allowed students to do."

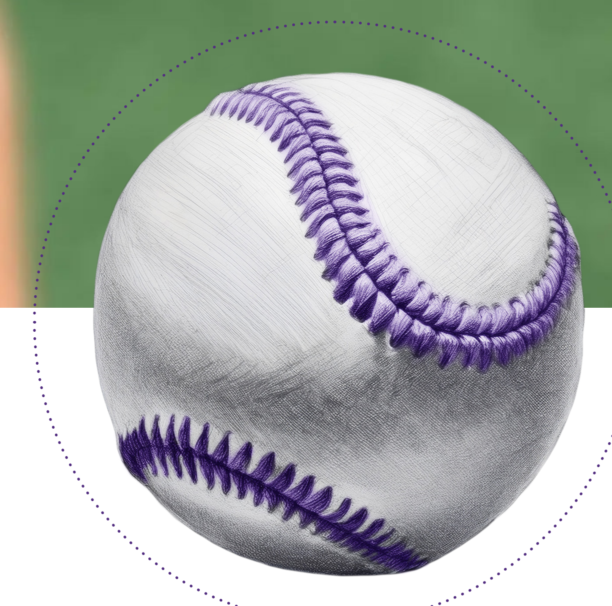
Additionally, Moore is the founder of Human RITHM, a data infrastructure company striving to set a new standard for human performance research by developing algorithms tailored to the needs of the people using them. Human RITHM's services include data infrastructure support, algorithm development, human performance insights and formal research reporting for its clients.

Post-grad, Moore is motivated to continue leading collaborations between athletics and academics.

"I think the more bright minds you put together and the more student engagement you can create, the better your outcomes tend to become," Moore said. "I'm most proud of what the baseball group has been, and I feel like that was done with the help of Jason, Shane [Bernhardson] and obviously lots of student engagement. So being able to lead something like that in a formal capacity would be awesome in my future career."

Clemson Olympic Sport Science is seeking baseball and softball analytics interns for upcoming semesters. Click here to apply. ■

Moore works on his laptop within the baseball training facility. His machine learning model uses Trackman data to evaluate pitcher injury prevention. ▶



Clemson Researchers Develop an Assistive Device to Help Athletes Recover from **Hamstring Injuries**

Clemson News | Katie Gerbasich

A graduate student in the Department of Bioengineering, ***Quinn Castner***, has spent the past year and a half refining this novel idea under the direction of Reed Gurchiek, Ph.D., assistant professor in the Department of Bioengineering, through the ***Human Movement Biomechanics Lab (HuMBL)***.

A model of the hamstring device is tested on an athlete in the Allen N. Reeves Football Complex at Clemson

This story was written by Katie Gerbasich, a senior sports communication student, as part of a project with the Robert H. Brooks Sports Science Institute.

Take a nylon webbed football belt, loop a resistance band through it and tape it down to the bottom of a football cleat. This was one of the initial ideas of Clemson Athletics' team orthopedic lead, Dr. Steve Martin, for a hamstring rehabilitation device.

A graduate student in the Department of Bioengineering, Quinn Castner, has spent the past year and a half refining this novel idea under the direction of Reed Gurchiek, Ph.D., assistant professor in the Department of Bioengineering, through the Human Movement Biomechanics Lab (HuMBL).

The team received research funding from Clemson University's Robert H. Brooks Sports Science Institute in 2024 to develop a passive assistive hamstring device. They aim to support the muscle recovery process.

The main component of the device is an elastic band that spans two joints, providing passive knee torque. When an athlete wears it, the elastic band offloads some of the hamstring muscle activity. It is highly modifiable, with approximately six different parameters that clinicians can adjust to create a customizable assistance profile.

> "As athletes are going through the rehab process, we'll start them off with the stiffest band that's going to help them the most," Castner said. "As they progress, clinicians can recommend bringing them down to a less stiff band, until ultimately, they won't need to use it at all."

Hamstring injuries are currently the most prevalent time-loss injury in field-based sports. As a Clemson Football athlete, Castner has witnessed many of his teammates being sidelined due to muscle tears. Athletes who have previously torn their hamstrings are at a higher risk of tearing it again.

A Clemson Football player is dressed in an initial prototype of the hamstring device

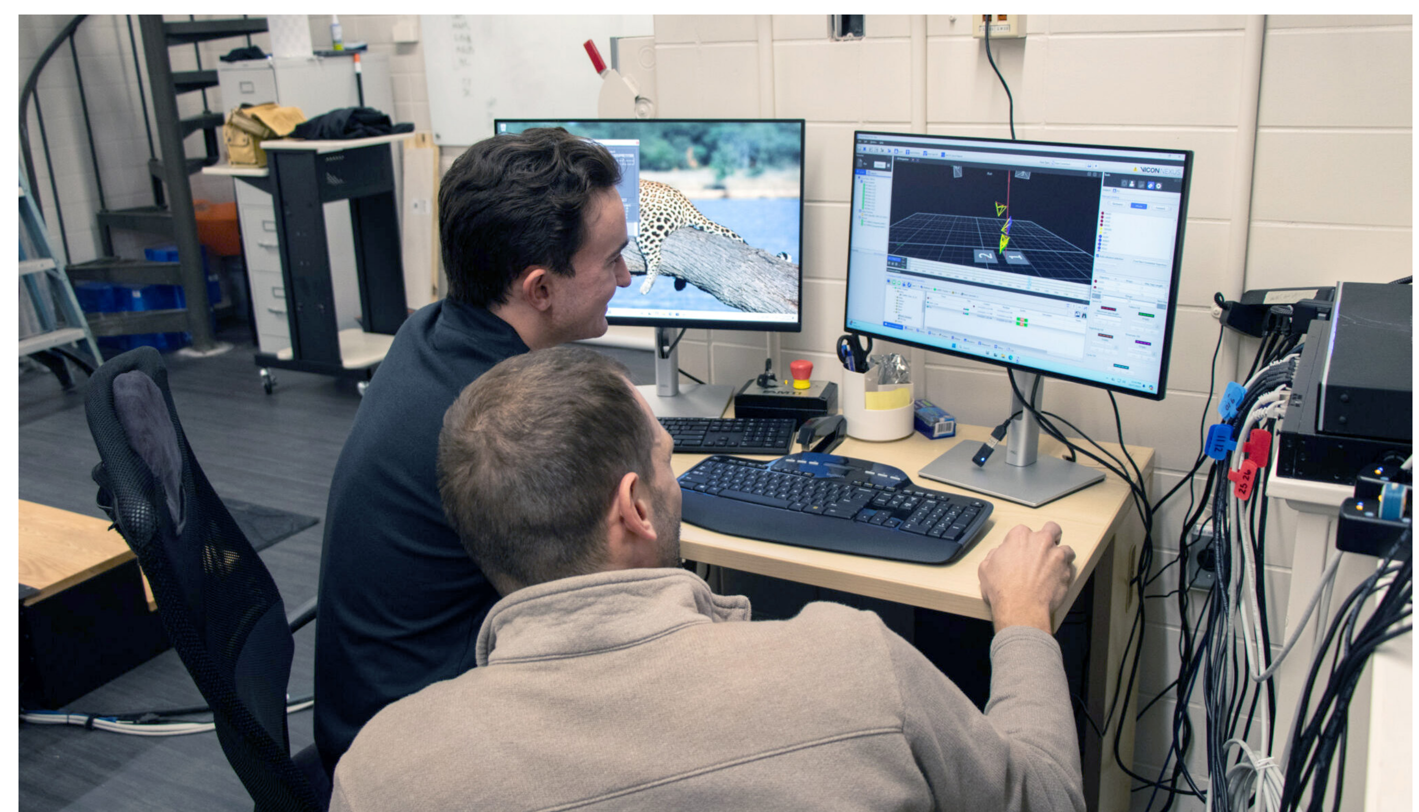
"The plaguing of hamstring reinjuries keeps these athletes out for weeks or months," Castner said. "It's unfortunate to see. Especially the fact that there's really not much of an answer to help this rehabilitation process to give these players a longer or better career."

Standard rehabilitation protocols typically entail reducing sprinting to allow the muscle time to heal.

"If you're an athlete and sprinting is a part of your sport, it's not good for you to go weeks without running," Gurchiek said. "It's not good for your cardiovascular or neuromuscular health. So the ideal scenario would be for the clinician to allow you to run, but to control how much load is imposed on the hamstrings."

Before coming to Clemson, Gurchiek studied human movement biomechanics and hamstring injuries at Stanford University as a postdoctoral fellow in the Wu Tsai Human Performance Alliance, focusing on bioengineering.

A combination of empirical and simulation-based methods has guided this research. The team wanted to ensure that the device did not hinder the athlete's natural running pattern. In an overground study, subjects ran 40-yard sprints on a field with and without the device to compare results.



Quinn Castner (left) and Reed Gurchiek, Ph.D. (right) analyze motion capture data from a previous subject in the Human Movement Biomechanics Lab (HuMBL)

"Across the testing conditions, there wasn't more than a 1 to 3 percent difference between wearing the device and not wearing the device," Castner said. "Which we've deemed, as such a small percentage, that it's most likely insignificant."

In a second study, the team sought to measure the extent to which the device actually offloads the hamstring muscle. Measuring the force produced in a muscle is challenging.

The team's solution was to use electromyography (EMG) sensors to record muscle activity.

> "The muscle activity measure that we're getting doesn't linearly translate to muscle force, but it acts as a surrogate measure," Gurchiek said. "Estimates of muscle force ultimately require simulation techniques."

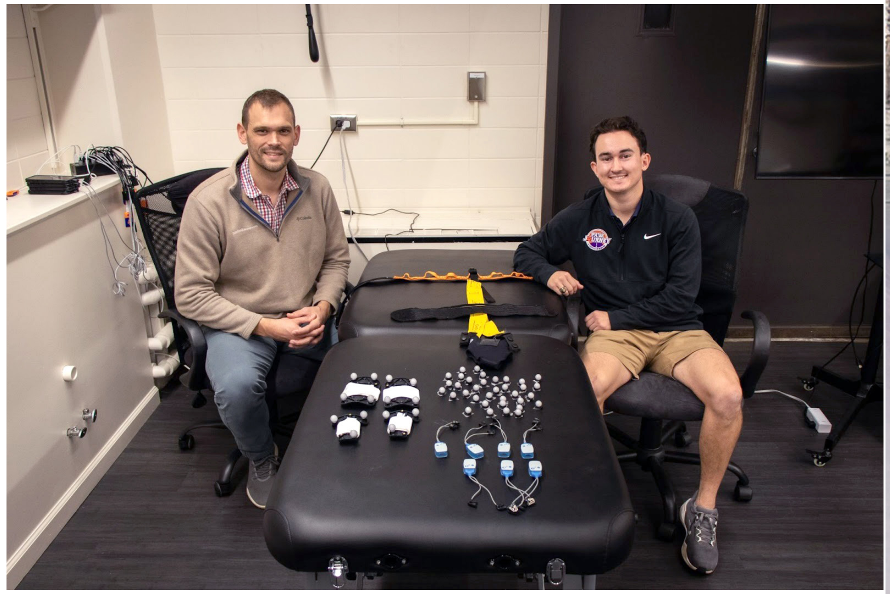
To produce these simulations, Gurchiek and Castner combined knowledge about the physiology of muscles, tendons and the motion of the runner to create a computer model.

"In the future, we'll use a model of the person along with the EMG data and simulation techniques to estimate how much force is going through the muscle," Gurchiek said.

So far, the device has shown promise in its ability to provide rehabilitative assistance. The team has kept Dr. Martin involved by sharing feedback about data and design features. Now, they're looking towards getting it into the field.

> "Once we have devices that are clean and can be worn by actual athletes in practice, that's the next step — putting it to work in actual rehabs and practices," Castner said. ■

Harrison Nodes, senior biomedical engineering student and undergraduate researcher, demonstrates the hamstring device. The bands and other components of the device can be adjusted to meet the athlete's specific needs.

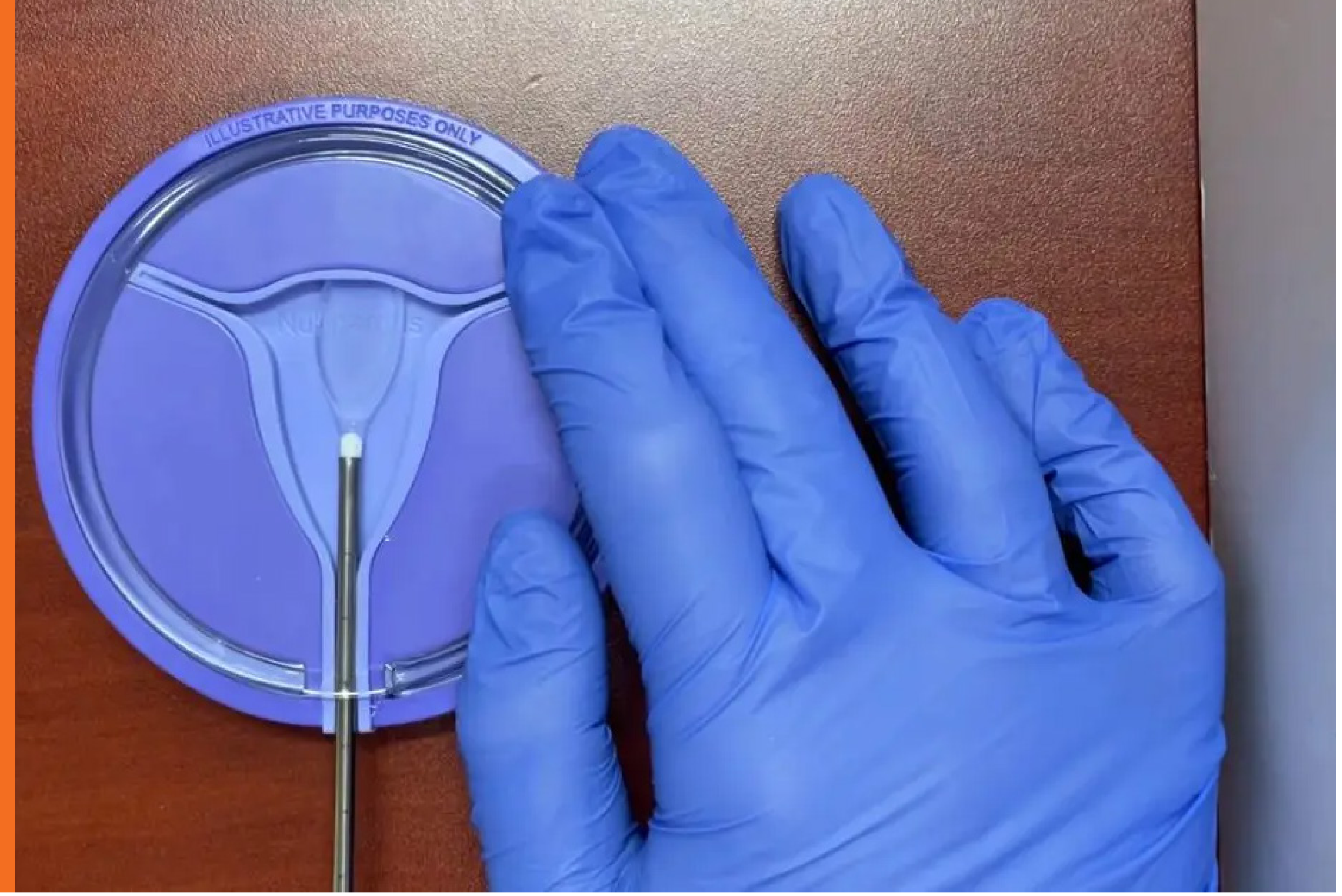


Gurchiek (left) and Castner (right) sit with the components of their hamstring device and motion capture setup.

Bioengineering Team Weighs Business Opportunities

after device wins national competition

Clemson News | Paul Alongi



The LidoSound is designed to act as a delivery system for lidocaine anesthetic.

The **LidoSound** was a senior design project last academic year for five bioengineering majors, who all graduated in May and are now in medical school, pursuing a Ph.D. or working in industry.

A Clemson University bioengineering team is seeking patent protection and exploring business opportunities after a device it created as part of a class project won a $15,000 national prize.

The LidoSound is designed to reduce the pain of intrauterine device (IUD) insertion. It was a senior design project last academic year for five bioengineering majors, who all graduated in May and are now in medical school, pursuing a Ph.D. or working in industry.

It was the latest Clemson victory in the annual DEBUT Challenge, sponsored by National Institute of Biomedical Imaging and Bioengineering (NIBIB).

The Clemson team won in a category called the Office of Research on Women's Health Technologies to Improve the Health of Women Prize.

The team consists of Jade Bowers, Landon Ethredge, Samantha McNabb, Audreanna Miserendino and Andrew Polson.

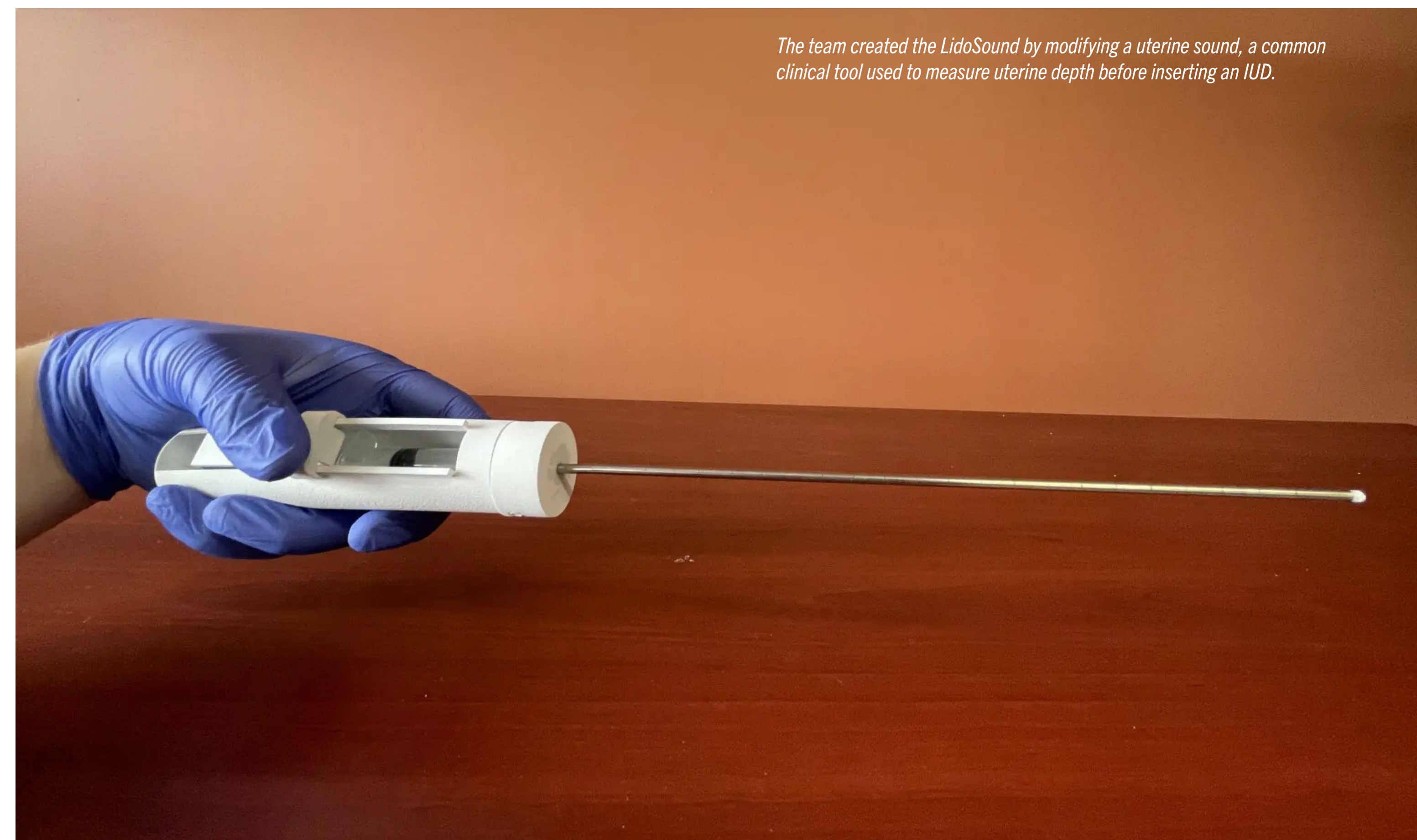
Their clinical collaborator was Dr. Christian Cook of Novant Health East Cooper OB/GYN in Mount Pleasant. Faculty advisors were: Tyler Harvey, senior lecturer in bioengineering; Vishal Thomas, lecturer in bioengineering and general engineering; and John DesJardins, the Hambright Distinguished Professor in Engineering Leadership.

The team created the LidoSound by modifying a uterine sound, a common clinical tool used to measure uterine depth before inserting an IUD.

But the LidoSound does more, acting as a delivery system for lidocaine anesthetic. As the device is withdrawn, the clinician pushes a sliding mechanism to dispense lidocaine through small holes at the tip, numbing the uterus and cervix.

This step is aimed at addressing the sharp pain patients often feel at the moment the IUD deploys inside the uterus. The team believes the same approach could also improve other procedures, such as endometrial biopsies and dilation and curettage.

Behind the design was nearly a year of brainstorming, trial and error, and long hours in a Rhodes Engineering Research Center conference room. The students started with prototypes made of pipe cleaners, straws and whatever else was handy to work out their ideas before moving on to refined versions.



The team created the LidoSound by modifying a uterine sound, a common clinical tool used to measure uterine depth before inserting an IUD.

But what began as a senior design project evolved into a device with market potential and momentum well beyond their original expectations. The team found that by 2032 the IUD market is expected to reach over 10 billion with a projected growth rate of 9.7%.

The students credit Dr. Cook for helping them focus on the biggest source of pain and their faculty advisors for pushing them to think not only about engineering but also about regulatory pathways, market needs and the realities of product design.

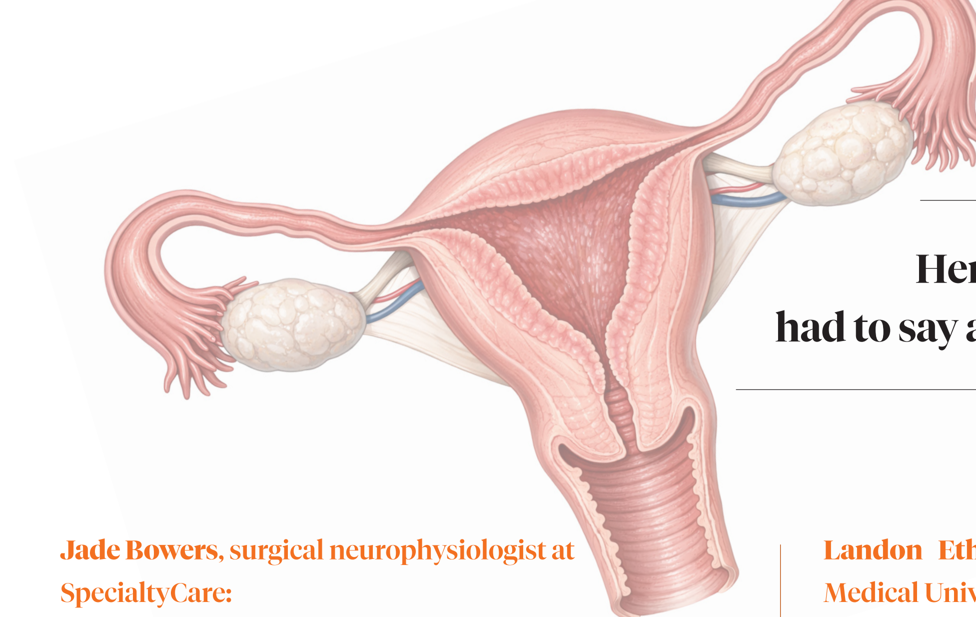
Along the way, they learned how to advocate for patients, how to simplify solutions to complex problems, and how to operate as a small start-up team under pressure.

DEBUT is an acronym for Design by Biomedical Undergraduate Teams. This year's challenge drew a record 123 teams representing 534 students from 67 universities in 24 states. Eleven top prizes were awarded by NIH and three by its partner VentureWell, along with five honorable mentions.

Clemson has built a strong track record in national bioengineering competitions. Since 2012, Clemson bioengineering teams have received NIH prizes 15 times and about $200,000 in design awards overall, in addition to top finishes in contests such as the Collegiate Inventors Competition, the ACC InVenture Prize and the Johns Hopkins Healthcare Design Competition.

The LidoSound previously won first place in the SPARK Challenge and second place in the Brook T. Smith LaunchPad Liftoff, both Clemson competitions. In all, the device has won the team $20,000 in prize money.

The team is now weighing whether to launch a company or work with manufacturers to bring the device to market.



Here is what each team member had to say about the LidoSound project:

Jade Bowers, surgical neurophysiologist at SpecialtyCare:

"Sometimes solutions don't have to be an overly complicated idea. We were told many times from people at competitions that they loved the simplicity of our solution. We modified an existing device to address a problem that had been overlooked. Sometimes the simplest answer is the best."

Landon Ethredge, first-year medical student at the Medical University of South Carolina in Charleston:

"I wasn't expecting to work in women's health for my senior design project, but it opened my eyes to how wide open the field is for innovation. Learning what goes into creating devices for real clinical needs was the most exciting part for me."

Samantha McNabb, Ph.D. student in biomedical engineering at Wake Forest University School of Medicine:

"What stood out to me was the support from our faculty and TAs. They encouraged us to submit to competitions we might not have entered otherwise, and that made all the difference. It reinforced how invested Clemson is in helping its students succeed."

Audreanna Miserendino, Ph.D. student in pharmaceutical engineering at the University of North Carolina:

"This project pushed me far beyond the classroom. We weren't just learning theory—we were making prototypes, filling out FDA paperwork, and tackling real-world problems as if we were running a small company. I learned more by doing than I ever could from lectures alone."

Andrew Polson, first-year medical student at the Medical University of South Carolina in Charleston:

"This project showed me the importance of advocacy within medicine. It gave me the chance to advocate for women's health and highlight gaps in care where devices like ours can make a difference. That lesson is going to stick with me throughout my career." ■

Bioengineering Ph.D. Student Showcases Innovative Surface-Cleaning Technology on FOX Carolina's Access Carolina

Sushant Sawant, a Ph.D. student, in Clemson University's Department of Bioengineering, was recently featured on FOX Carolina's Access Carolina, where he showcased his research on long-lasting, natural disinfectants. During the interview with host Margaret Burnquist, Sawant demonstrated how the technology works and shared how engineering innovation can help reduce hospital-acquired infections by improving surface hygiene in healthcare and public environments.

[*The following article explores the research behind this work and its significance for medical and surface-cleaning applications. (Editor)*]

Engineering Long-Lasting Natural Disinfectants to Prevent Hospital-Acquired Infections

Sushant Sawant

Hospital-acquired infections (HAIs) remain one of the most persistent challenges in modern healthcare, particularly because frequently touched surfaces, such as door handles, elevator buttons, bed rails, and touchscreen interfaces, can become recontaminated within minutes after cleaning. Traditional disinfectants are effective at the moment of application, but their antimicrobial activity generally lasts only 4-6 hours, leaving long windows of vulnerability where harmful pathogens can spread.

The COVID-19 pandemic made this vulnerability unmistakably clear. During the early stages of the pandemic, hospitals, nursing homes, and public facilities saw firsthand how rapidly viruses and other microbes can move through built environments. Surfaces that appear to be clean could still act as reservoirs for transmission, reinforcing the need for longer-lasting, more resilient environmental hygiene solutions.

Sushant Sawant, a Ph.D. student in Clemson University's Bioengineering Department, is working to close this gap by developing a natural, long-lasting, film-forming disinfectant that provides extended protection for up to 72 hours. His research is a part of a larger NIH-funded effort led by Dr Alexey Vertical, focused on creating next-generation antimicrobial surface technologies for hospitals and public environments.

At the centre of Sushant's work is chitosan, a biodegradable polymer derived from the shells of crustaceans. While chitosan has mild inherent antimicrobial properties, Sushant's research involves chemically modifying and formulating it with natural antimicrobial agents to produce a stable, high-performance disinfectant. When applied to a surface, the material forms an invisible protective layer that continuously kills bacteria and viruses, reducing the microbial load far more effectively than conventional products on the market.

Whatch on FOX Carolina: click or scan

This innovation aligns with the NIH Phase II SBIR grant from the National Institute of Allergy and Infectious Diseases (NIAID), supporting regulatory testing and multi-site field trials in real hospital settings. Early results from lab studies show a significant reduction in microbial survival on treated surfaces, demonstrating strong potential to reduce surface-mediated transmission of HAIs.

Sushant's work has also gained public visibility. He was recently invited to present and discuss his research on Fox Carolina news, where he demonstrated how the long-lasting disinfectant works and explained its potential to improve surface hygiene in healthcare and community settings.

Beyond the formulation itself, Sushant is interested in understanding how these materials interact with different surface chemistries, how long-term antimicrobial activity can be stabilised, and how to engineer films that balance durability with safe biodegradation. His work bridges material science, microbiology, and clinical translational engineering, aiming to deliver a practical solution that hospitals can adopt without workflow disruptions.

Sushant notes that his motivation is rooted in real-world impact:

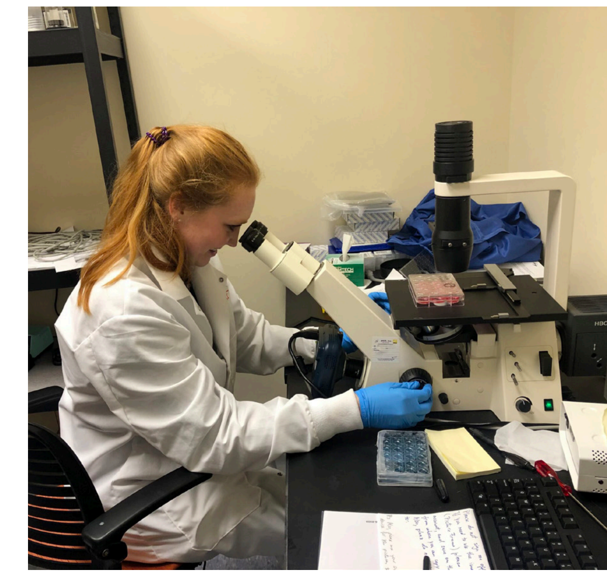
"My goal is to engineer solutions that directly reduce infections and improve patient safety. If we can create a disinfectant that works for days instead of hours, we can meaningfully change how hospitals can manage environmental contamination."

His ongoing research encompasses formulation and development, mechanistic study of antimicrobial actions, durability testing on multiple surface types, and preparation for clinical-grade product evaluation. Sushant's work reflects Clemson Bioengineering's commitment to tackling critical healthcare challenges through innovative material-driven approaches. ■

GOOD MEDICINE:
From college coursework to health care career

Clemson News | Scott Miller

Two-time Clemson graduate Emily DiNicola's pursuit of bioengineering, including clinical work with CUBEInC, led her directly to employment with a young biologics company in Greenville.



A high school tennis player who had surgery on both knees, Emily DiNicola was familiar with hospitals.

She began her college career at Anderson University with plans to attend medical school to become a doctor. That quickly changed, though she still had the itch to work in health care.

DiNicola transferred to Clemson and as a sophomore in 2019 found herself interning at CUBEInC with the Department of Bioengineering. She would provide research support, analyzing cell cultures, for example, for Clemson faculty members working at CUBEInC and had an opportunity to work on a clinical trial sponsored by Steadman Hawkins, which also has space at Prisma Health's Patewood campus.

The research team was working on biologics, therapeutics derived from living organisms.

"It put me way ahead when I was going into graduate school because I knew how to conduct the research," Emily said. "I had learned about tissue engineering as a sophomore at CUBEInC. That was a class you couldn't take until you were a senior."

DiNicola studied under the tutelage of former Clemson professor Jeremy Mercuri, who now works as chief scientist of a startup company at CUBEInC called Samaritan Biologics. DiNicola earned her bachelor's degree in 2021 and then her Ph.D. in bioengineering at Clemson in May 2025. She was quickly hired by Samaritan.

Samaritan develops, manufactures and distributes human amniotic allograft products for wound care and surgical applications. The young company still has a lab at CUBEInC but established an 11,000-square-foot manufacturing facility on the Clemson University International Center for Automotive Research (CU-ICAR) campus in Greenville.

"As we were searching for a home where we could build upon our research and continually develop and evolve our products, the team at Samaritan Biologics felt that CUBEInC could not have offered a more perfect space," said CEO David Szalay.

"This research facility has helped catapult our boot-strapped startup into a successful and sustainable company, offering some of the most sought-after allograft products available today," Szalay said. "We're constantly inspired by the great minds who walk the halls of this building and share the same passion as us to help people through science and drive the future of biotech and medtech." ■

NEW FACULTY

NEW FACULTY SPOTLIGHT

SPOTLIGHT

Shivani Arora, Ph.D.

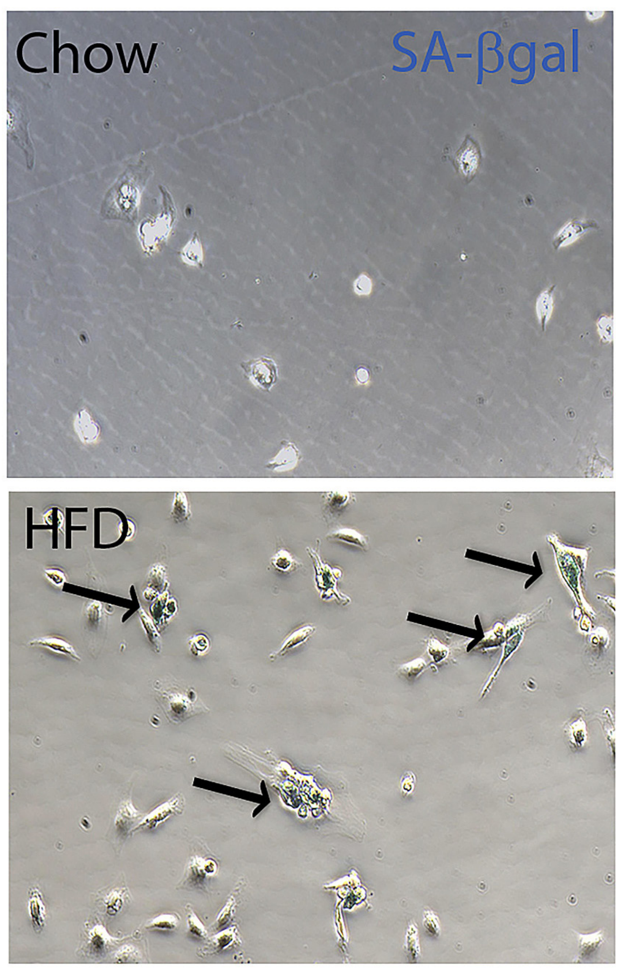
Dr. Shivani Arora is a Research Assistant Professor in the Department of Bioengineering at Clemson University, where her research focuses on understanding how cellular senescence reshapes the immune microenvironment and drives aging-associated cardiovascular pathologies. Her interdisciplinary program integrates molecular immunology, targeted drug delivery, proteomics, and nanoparticle engineering to develop novel therapeutics for myocardial infarction, chronic heart failure, and chronic inflammatory diseases such as pulmonary fibrosis and hepatic steatosis.

Dr. Arora's research group investigates mechanisms regulating the senescence-associated secretory phenotype (SASP) in cardiac cells, with a particular emphasis on NLRP3 inflammasome biology and senescence–immune crosstalk. Leveraging this mechanistic insight, she is developing cardiomyocyte-targeted nanoparticle platforms (Nano-TRIM and PROTAC-based biologics) to selectively inhibit or degrade intracellular NLRP3 as a strategy to limit cardiac inflammation and adverse remodeling. Her work spans advanced in vitro systems, rodent models of cardiac injury, and computational design of antibody- and nanobody-based degraders.

Dr. Arora brings extensive experience across pharmacology, immunology, intracellular drug delivery, and cardiovascular pathology. She completed her Ph.D. in Biomedical Science at the University of Delhi, followed by postdoctoral training at the University of California, San Francisco (UCSF), where she studied innate-like immune cell–mediated clearance of senescent cells. At Clemson University, she later served as a Postdoctoral Fellow contributing to NIH-funded research on vascular calcification and aneurysm biology before joining the research track faculty.

Her research has been supported by the Larry L. Hillblom Foundation, the Diabetes Research Connection. She has authored over 12 peer-reviewed publications, filed a provisional patent on targeted intracellular chelation technologies, and is actively mentoring undergraduate and co-mentoring graduate researchers in bioengineering.

Dr. Arora's long-term goal is to translate fundamental discoveries in senescence and immune biology into targeted, first-in-class therapeutics for cardiovascular disease and aging-related disorders.



◀ *Images for the article "Invariant natural killer T cells coordinate removal of senescent cells" (published in "Science Direct", 2021)*

Carolyn Banister, Ph.D., MLS^{CM}(ASCP) MB^{CM} SCT

Dr. Carolyn Banister is an Assistant Professor in Bioengineering at Clemson University. She is a molecular biologist and clinical laboratory scientist whose career integrates foundational discovery in genomics with the development of innovative diagnostic tools that address urgent clinical needs. She earned her Ph.D. at the University of South Carolina, where she built a research program spanning next-generation sequencing, molecular epidemiology, epigenetics, and translational assay development. Throughout her career, Dr. Banister has shown a deep commitment to transforming scientific insight into practical applications that improve patient care.

Dr. Banister's early research in cancer genomics produced several landmark contributions. She published the first comprehensive multi-omics analysis of cervical cancer, identifying a previously unrecognized subset of HPV-independent tumors that reshaped understanding of cervical carcinogenesis. In one of the earliest large-scale sequencing studies of metastatic melanoma, she mapped the mutation frequencies and genetic interactions among more than 20 melanoma driver genes—findings that have since been validated widely and remain foundational in the field. Her work also expanded into molecular epidemiology, where she conducted exome sequencing and population-based studies to uncover germline modulators of HPV persistence and cervical cancer risk among African American women.

During her postdoctoral training at the Warren Alpert Medical School of Brown University, Dr. Banister conducted pioneering work in developmental epigenetics. She was the first to identify a DNA-methylation signature predictive of infant intrauterine growth and developmental abnormalities, opening new possibilities for early diagnosis in high-risk pregnancies.

In 2017, Dr. Banister received an NIH Phase I SBIR award to establish and characterize personalized colon cancer organoid "avatars" paired with matched normal tissue. This platform integrates somatic and germline variants identified through whole-exome sequencing with in-vitro drug sensitivity testing across 12 FDA-approved chemotherapies. The overarching goal is to identify genetic features that predict therapeutic response or adverse effects, distinguishing tumor-specific vulnerabilities from inherent patient sensitivities.

This program resulted in the creation of a living biobank of tumor/normal organoid pairs from 50 colon cancer patients. To date, in-vitro testing of 15 chemotherapeutic agents has been performed on 30 unique patient samples. By integrating these findings with exome sequencing, Dr. Banister is uncovering the genetic determinants of drug response. Expansion of this biobank to more than 1,500 cryopreserved, well-characterized samples mark a major milestone and positions the platform for large-scale screening and collaborative translational research. Organoids from other body sites such as breast, lung, and liver have also been banked.

Looking ahead, Dr. Banister plans to extend this platform to early-onset colorectal cancer, with a focus on evaluating persistent epigenetic alterations associated with long-term psychological stress. Additional collaborative projects are in development to assess environmental toxin exposure in cancer development and to test next-generation drug delivery systems designed to reduce off-target toxicity.

From 2020 to 2023, Dr. Banister brought her research expertise fully into the clinical arena. She developed a saliva-based SARS-CoV-2 diagnostic test, established a CLIA-certified diagnostic laboratory at the University of South Carolina, and led statewide testing throughout the COVID-19 pandemic. This work not only supported public health efforts but also reinforced her commitment to advancing diagnostic technologies that meet real-world clinical needs.

During the pandemic, Dr. Banister began expanding her work in saliva-based diagnostics to explore additional biomarkers with clinical relevance. She is now pursuing the development of a diagnostic test to objectively confirm concussion and traumatic brain injury (TBI). Her current clinical studies aim to identify reliable molecular signatures of concussion that can form the basis for point-of-care and at-home diagnostic tools for neurological, aging-related, and other brain health conditions. This work has the potential to yield the first field-deployable diagnostic test capable of guiding safe return-to-play decisions for athletes.

In addition to her research achievements, Dr. Banister is a dedicated teacher and mentor. She fosters a collaborative, hands-on research environment that prepares students for careers in medicine, biotechnology, diagnostics, and clinical laboratory science. Her mentorship philosophy emphasizes creativity, independence, and scientific rigor, empowering trainees to explore diverse interests across genomics, bioengineering, and translational diagnostics.

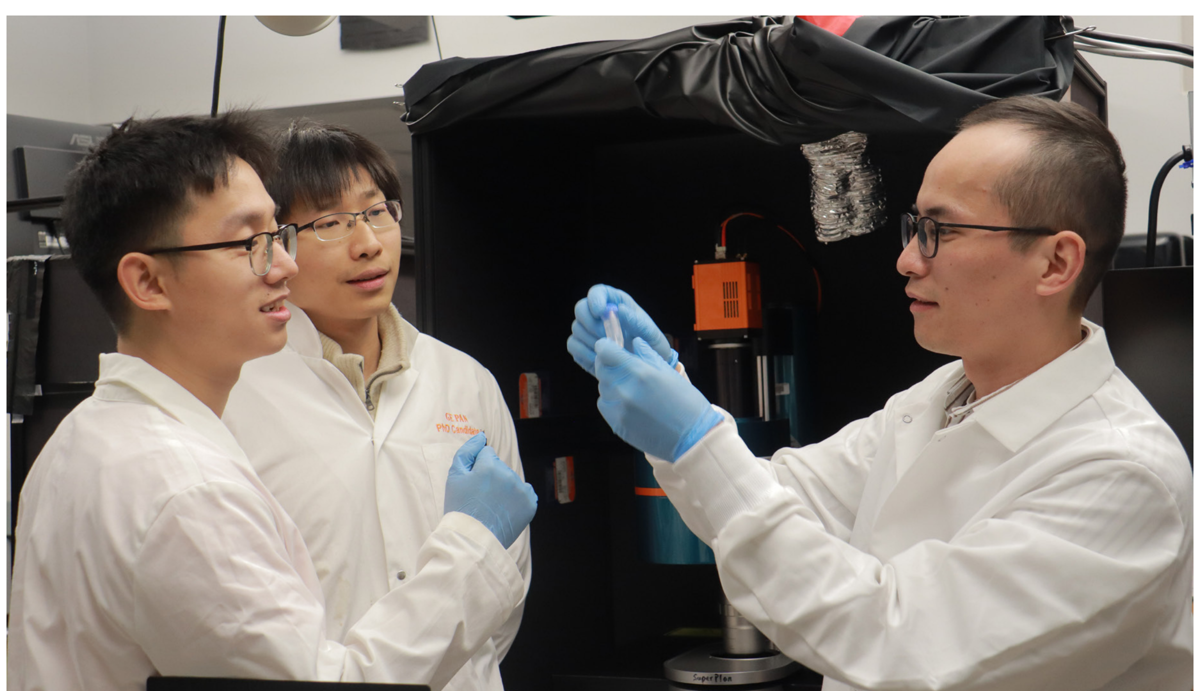
We look forward to Dr. Banister's continued leadership in translational molecular diagnostics, her innovative contributions to concussion research, and her commitment to training the next generation of scientists and clinical laboratory professionals.

Peng Chen, Ph.D.

We are thrilled to welcome ***Dr. Peng Chen*** as a new tenure-track Assistant Professor, jointly recruited by the Department of Bioengineering and MUSC's College of Dental Medicine. Dr. Chen earned his Bachelor's degree in Physics and completed his Ph.D. in Bioengineering at Clemson University in 2020. He then pursued postdoctoral training in the Clemson–MUSC Bioengineering Program, where he was promoted to Research Assistant Professor in 2024.

Dr. Chen's research expertise spans bioimaging, biotransport, biomechanics, computational modeling, cell phenotyping, tissue cryopreservation, and joint repair. His laboratory implements a whole-joint, whole-body framework and employs multiscale, multiphysical, and multiplex approaches to quantitatively and spatiotemporally decipher complex cellular and molecular events during tissue development and disease progression. His work aims both to deepen fundamental understanding of the mechanisms driving musculoskeletal diseases and to develop effective therapeutic strategies that improve patient care. Dr. Chen has developed several transformative tools that have advanced the field. He pioneered the first 3D whole-joint mapping method (MUSIC), which quantitatively characterizes the spatiotemporal cellular and molecular landscape of joints and offers a powerful platform for probing the relationship between joint structure, function, and pain. He also developed the first noninvasive, imaging-based platform (LiFT-FRAP) for measuring 3D tissue structure, molecular dynamics, and transport properties—a method now widely adopted and recognized as a standard for characterizing tissue-engineering scaffolds. In parallel, Dr. Chen has advanced tissue preservation for osteochondral allograft transplantation through novel vitrification and nanowarming approaches, which have since been extended to cryopreservation of the knee meniscus and temporomandibular joint (TMJ) disc. Through transdisciplinary collaborations, he has also identified a key cell niche essential for cartilage homeostasis and developed an injectable drug targeting this population to promote cartilage repair. Dr. Chen's research has been published in high-profile journals, including Nature Communications, Advanced Science, Cell Stem Cell, Communications Biology, and Advanced Healthcare Materials.

Dr Chen's research excellence has been recognized with several honors, including the Dr. James Neff Research Award from MTF Biologics and his selection as a finalist for both the AADOCR and ORS New Investigator Awards. Dr. Chen's research is funded by NIH and MTF Biologics. He serves as a research project leader for the NIH COBRE Center SC-TRIMH and is a Co-Investigator on a major multi-institutional collaboration. Beyond his achievements in basic research, Dr. Chen is an inventor on multiple patents and actively involved in translational initiatives, including Clemson's STRIDE program, funded by the NSF's Accelerating Research Translation (ART) grant. Dr. Chen exemplifies a researcher capable of bridging basic science with translational approaches in musculoskeletal research.



Janine Hoelscher, Ph.D.

Dr. Janine Hoelscher joined the Department of Bioengineering at Clemson University as an Assistant Professor in 2024. She received her undergraduate and master's degrees in Computer Science from the Technical University of Darmstadt, Germany. Subsequently, she completed her Ph.D. in Computer Science at the University of North Carolina at Chapel Hill. Her research interests reside at the intersection of medical robotics, image analysis, human-computer interaction (HCI), and explainable AI (XAI), with a focus on advancing the safety and clinical usability of AI applications in the medical domain.

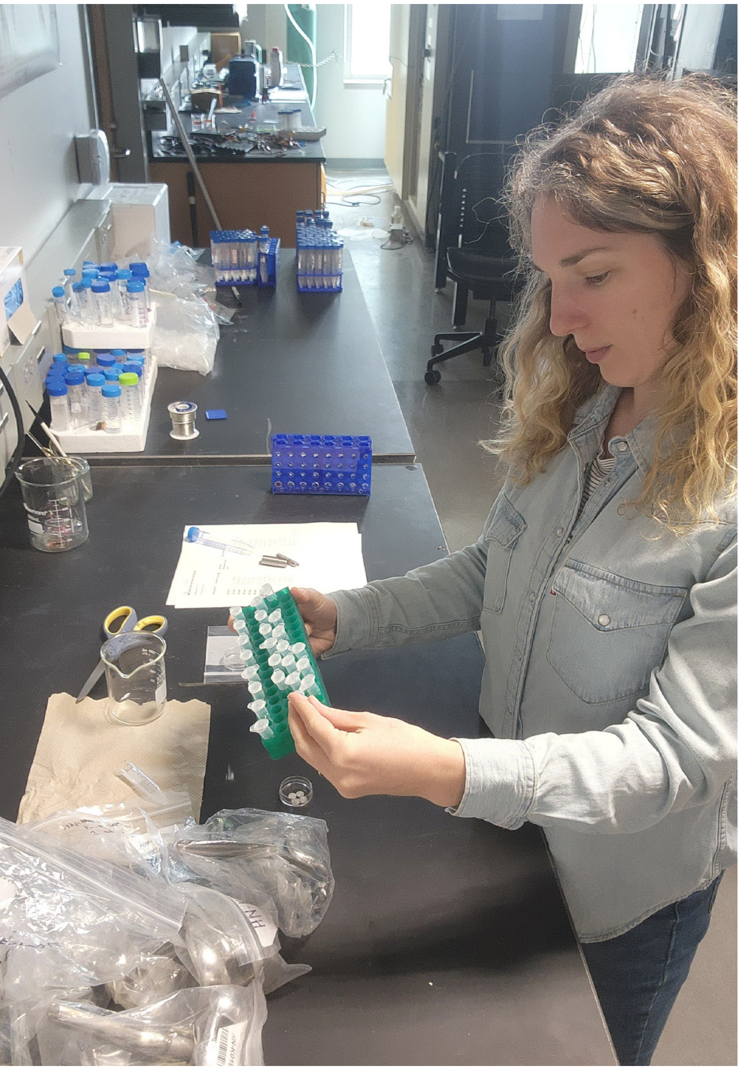
Dr. Hoelscher's work focuses on the development of autonomous systems designed to effectively assist physicians by automating standardized tasks and ensuring high performance under the supervision of a clinician. Her research applies advanced deep learning and computer vision techniques to analyze complex medical imaging data, including MRI and ultrasound, for applications in both diagnosis and surgical intervention. A significant earlier contribution to this field was her role in developing a prototype steerable needle robot for lung biopsies, which demonstrated successful implementation in in vivo studies. A recent example of her work in clinical decision support is a deep learning tool for Emergency Room (ER) risk prediction. This tool goes beyond mere identification, providing necessary context by analyzing clinical notes and measurements to explain its reasoning to a physician. This work highlights her overarching goal of integrating Explainable AI (XAI) to make sense of large amounts of data and presenting it in an intuitive, easily understandable way. Her commitment to advancing translational biomedical research is supported by her appointment as a Faculty Scholar at the Clemson University School of Health Research (CUSHR). Furthermore, Dr. Hoelscher is part of the SC ADAPT project, contributing her expertise in AI-enabled biomedical device research toward improving healthcare outcomes across the state.

Dr. Hoelscher is dedicated to mentoring and preparing the next generation of bioengineers for both industry and academic careers. She currently teaches an Introduction to Data Science course and an advanced course on AI for Image Analysis, both of which focus on biomedical applications. Furthermore, she directs a Creative Inquiry course where students gain hands-on experience by building an intelligent robot assistant for a hospital setting that can respond to speech commands, exploring state-of-the-art AI tools in a high-risk environment.

Amandine Impergre, Ph.D.

Dr. Amandine Impergre joined Clemson University as Research Assistant Professor of Bioengineering in October 2024, working in the laboratory of Dr. Gilbert. Her research focuses on corrosion, degradation, and tribology of metallic medical implants in interaction with biological tissues. Positioned at the interface of materials engineering, electrochemistry, and biomedical science, her work seeks to understand and mitigate the failure mechanisms of metallic implants and the biological consequences of their degradation.

Her research program spans a broad range of metallic implant systems—including orthopedic, dental, and other long-term implantable devices—with the overarching goal of improving implant durability, evaluating biocompatibility, and supporting safer clinical outcomes. She investigates corrosion and tribocorrosion mechanisms in complex cell culture environments, particularly the influence of phospholipid vesicles, hyaluronic acid, and other organic components of synovial fluid. She also examines additively manufactured (3D-printed) CoCrMo alloys, assessing how processing parameters affect metallurgical microstructure, porosity, and corrosion resistance.



A significant portion of her work focuses on the biological impact of degradation products. She is investigating the cytotoxicity of tin alloys, that has been used in the context of Essure sterilization implants for women, including complementary in vivo mouse implantation studies comparing tin alloys, stainless steel, and magnesium alloys to evaluate histological and fibrotic responses.

She also contributes to investigations of hemi-arthroplasty implants, including pyrolytic carbon for the shoulder implant. Using specific simulators, she compared biomaterials (cobalt alloy, ceramic, pyrolytic carbon) articulating against live bovine cartilage and evaluated the tissue degradation through biomarkers and structural evaluation. More recently, she focuses on retrieval analysis of temporomandibular joint (TMJ) hemi implants in collaboration with Mayo Clinic and Rush University Medical Center. Through her work, she aims to correlate surface chemistry with implantation time, identify failure modes, and define surface-based indicators of long-term performance.

She is also developing new methodologies to study biological tissues using electrochemical techniques. Her recent SUCCEEDS grant supports the development of EIS-based approaches to probe ionic transport, porosity, and intrinsic structural features of cartilage, coupled with AFM to correlate topographical and electrochemical properties.

Dr. Amandine Impergre earned her PhD in Materials Science and Engineering from INSA Lyon in France, after completing a master's degree in corrosion, degradation, and protection of materials at La Rochelle University, France. Prior to joining Clemson, she was a postdoctoral researcher and later the Tribology Laboratory Supervisor at Rush University Medical Center in Chicago, IL. She is currently the Vice Chair of the Orthopaedic SIG of the Society For Biomaterials (SFB) and previously served on the Membership Committee of the Orthopaedic Research Society (ORS).

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