DISJOINTED
AT THE HIP

▲ Thomas D. Brown, PhD

OREF recognizes research on total hip arthroplasty

Instability has become the most common reason for total hip replacement failure. It occurs in 2% to 5% of primary total hip arthroplasty (THA) surgeries and 5% to 10% of THA revision surgeries. Dislocation is a well-recognized reason for clinical failure, but impingement and subluxation also have been implicated in a new set of concerns with advanced bearings. Yet the biomechanical factors responsible for dislocation, impingement and subluxation have been an underdeveloped area of investigation.

For his efforts in the study of dislocation after THA, **Thomas D. Brown, PhD**, Richard and Janice Johnston chair of Orthopaedic Biomechanics, director of the Orthopaedic Biomechanics Laboratory and professor of Orthopaedics and Rehabilitation and of Biomedical Engineering at the University of Iowa, was awarded the 2012 OREF Clinical Research Award. Among Dr. Brown's colleagues on the project, **Jacob Matthias Elkins, MS**, an MD-PhD candidate of the university's Medical Scientist Training Program, **Douglas R. Pedersen, PhD**, research associate professor, Orthopaedics and Rehabilitation, and **John J. Callaghan, MD**, professor of Orthopaedics and Rehabilitation and of Biomedical Engineering, co-authored the winning manuscript.

ENGINEERING ORTHOPAEDICS

Dr. Brown's career in orthopaedics began serendipitously when the engineer he'd been training under, aware of his trainee's background in fluid mechanics engineering, happened to be working with an anesthesiologist. . .who knew an academic orthopaedic surgeon. . .who was looking for an engineer to work on a project. Since then, Dr. Brown's work has been concentrated in computer modeling.

"It works well for our laboratory to tackle problems with computer modeling," said Dr. Brown. "You can find a lot of answers that you can't get from physical experiments and that you certainly can't get from clinical data."

Dr. Brown began researching impingement/dislocation complications of THA because he recognized that the reasons for it were poorly understood.

"There was a set of problems occurring clinically that nobody had a systematic way to study or understand or ask questions about," he said. "By 2009, impingement and dislocation had surpassed problems with wear and associated loosening as the most common causes for failure with total hips."

INVESTIGATING CAUSES OF DISLOCATION

Because the unpredictability and abruptness of dislocation represent what he calls "major hurdles" to drawing conclusions from clinical experience, and because dislocation cannot be well-studied with existing approaches, Dr. Brown and his team created new research methods focused on advanced finite element formulations. They developed and validated clinically realistic 3-D computer models to understand how implant design, surgical positioning decisions and patient motion contribute to impingement and dislocation.

They also performed a long-term follow-up study of individual surgeons' experiences treating dislocation after THA by looking at their case histories. As a result, the team was able to test many surgeon, implant and patient variables. Over the last 15 years, this research has helped to improve the scientific basis for understanding total hip impingement and dislocation.

"Using these models to target questions of implant design, surgeon usage, surgeon implantation, and do's and don'ts for patients all fit together beautifully," Dr. Brown said.

However, he added, researchers cannot find answers to these questions from clinical experience alone.

"There is a lot of disagreement about what the desirable and undesirable design features are in certain manufacturers' total hip devices that may make those devices more or less prone to impinge or dislocate," Dr. Brown said. The team addressed a

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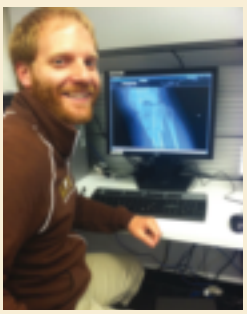

FRACTURE CARE
Pre- and Postoperatively, Ice Could Be Nice: OREF grant recipient investigates the effects of cryotherapy on fracture patients

UNIVERSITY OF IOWA FOUR-PEAT

This is the second consecutive year, third time this decade, and fourth time overall that researchers from the University of Iowa received the OREF Clinical Research Award. In 2011, primary author **Donald D. Anderson, PhD** teamed with co-authors **J. Lawrence Marsh, MD** and **Thomas D. Brown, PhD**—primary author of this year's winning manuscript—to pen the winning submission for research of post-traumatic osteoarthritis following intra-articular fractures. In 2003, **John J. Callaghan, MD**, who co-authored this year's winning entry, was the lead author on "The Clinical Biomechanics of Wear in Total Hip Arthroplasty." Dr. Callaghan's co-authors were: **Douglas R. Pedersen, PhD**, **Richard C. Johnston, MD**, and Dr. Brown. **Stuart L. Weinstein, MD** received the award in 1998 for his outcomes research on the treatment of pediatric orthopaedic conditions.

Photo courtesy of Dr. Brown.

number of biomechanical issues related to this question and made some recommendations.

One such recommendation involved patients who are morbidly obese. When obese patients stand up, Dr. Brown said, their thighs often come together, creating an outward force on the hip joints that tends to trigger dislocation after THA. Dr. Brown and his team suggested using high-offset femoral necks (implants with longer femoral necks than would be used in a patient of average weight) to decrease the likelihood of dislocation.

BIOMECHANICS FOR THE FUTURE

Going forward, Dr. Brown is optimistic about the benefit of computer modeling. "It's opened biomechanics up to scientific investigation in a way that it wasn't before," he said. But he acknowledges that it is still a work in progress. He and his team continue to update their computer models and add to the database of motion analysis and mechanical properties of tissues to answer questions that continually arise from clinical experience. While it might not be possible to predict which individual patients will develop instability after THA, biomechanical evidence can help surgeons make informed treatment decisions that will reduce the risk.

Between 1976 and 1983, Dr. Brown was a research assistant professor of orthopaedics and civil engineering at the University of Pittsburgh before being appointed as associate professor of Orthopaedic Surgery and Biomedical Engineering at the University of Iowa, where he holds his present positions. He played leadership roles as president of the American Society of Biomechanics in 1983 and of the Orthopaedic Research Society in 2001. In 1986, Dr. Brown was awarded the American Academy of Orthopaedic Surgeons Kappa Delta Award for his work on noninvasively measuring blood flow in digital arteries. He also co-authored the manuscripts that were the basis for his research team receiving the OREF Clinical Research Award in 2003 and 2011. ■

◀ Dr. Brown in his testing lab. To his left is a Material Testing Systems hip loading apparatus used to take cadaver measurements. Dr. Brown and his research team developed and validated clinically realistic 3-D computer models to understand how implant design, surgical positioning decisions and patient motion contribute to impingement and dislocation after total hip replacement.