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Award Winning Research Studies Prove Long-Term Benefits and Address Contemporary Concerns

Dr. Andy Engh (left) and Dr. Bill Hamilton (right) proudly display their recent awards.

The Anderson Orthopaedic Research Institute (AORI) was honored to receive two awards for its research during the past year. In January, we were notified that a study led by Dr. Andy Engh had received the Aufranc Award from the Hip Society. This prestigious award, named after Dr. Otto Aufranc, who developed one of the first American hip replacements, recognizes innovative research addressing important advances in the management of hip disorders. At the Open Meeting of the Hip Society during the March 2017 American Academy of Orthopaedic Surgeons Conference, Dr. Andy and his co-authors were presented with the Aufranc Award for evaluating the long-term performance of crosslinked polyethylene. Following up on Dr. Goyal's study that won the Aufranc Award in 2016, this is the first time that AORI has won back-to-back Hip Society Awards. In September, we learned that a study led by Dr. Bill Hamilton had won the Lawrence D. Dorr Surgical Techniques and Technologies Award from the American Association of Hip and Knee Surgeons (AAHKS). The purpose of the Dorr Award is to instill continuing interest in surgical innovation and new techniques within reconstructive surgery. Dr. Hamilton's award-winning research used over 16,000 hip and knee replacement procedures archived in AORI's institutional database to evaluate whether changes in how joint replacements are performed have had any impact on patient outcome during the first 90 days after surgery. The unique nature of each study illustrates how AORI uses a variety of techniques to answer the questions that confront joint replacement patients and their healthcare providers.

The origin of Dr. Andy Engh's study can be traced back to the late 1990s when he and his father, Dr. Charles Engh, were trying to reduce the wear rates associated with the hip replacements they performed. During his career, Dr. Charles Engh's long-standing ambition was to offer his hip replacement patients an implant that would last their entire lives. This goal motivated him to pioneer biologic fixation using a porous metal surface that allows a patient's bone to grow into the implant, creating a durable bond that is maintained by the patient's own body. Although

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Cornell Reddon Hip Replacement Patient, Living Life According to *The Engh Standard*

By Renée Burkett

When he was younger, Cornell Reddon dreamed of playing football in high school and maybe beyond. He looked forward to enjoying the cheering crowds underneath those Friday Night Lights. So, as an aspiring wide receiver, he went out with friends to practice one day. He was about 14 years old.

Aspirations to Have a Football Career Cut Short

"My buddy told me to go out for a pass, so I did," says Cornell. Practicing running routes and catching passes was his sole aim. He knew he was fast. With practice, he could become not just faster, but also able to leap in the air and catch those hard to reach balls. He could see himself doing it. He could imagine the joy of scoring the winning touchdown. But something happened in his effort to catch a pass that day. He reached for the ball and caught it but then fell, landing in an awkward position on his left hip. The fall did considerable damage to his pelvis and caused a hairline fracture that could not be repaired. "My doctor told me I needed a hip replacement." However, he was much too young for the surgery since his growth plates were still open.

Cornell recounts the agony associated with that fall and the lasting effects prior to his hip replacement surgery. "For ten years, I had to walk around with a limp on canes or even crutches. I would hurt so badly, I would take hot baths to loosen my muscles just so I could get out of the house and go to school." Cornell had great difficulty bending at the hip, so

Cornell Reddon is a successful businessman, author and entrepreneur.

even riding to school with friends was challenging. He had to sit in the back seat of friends' cars with his left leg stretched across the seat. His limited hip motion meant no movies or concerts, "unless I sat in the front row," Cornell explains. "I could not even go to amusement parks. Tenth grade through my college years were some of the most miserable years of my life."

More Disappointment

When Cornell was old enough to consider a hip replacement, he received more bad news. "In 1991, while I was in college, I was diagnosed with cancer and of all places, I had it in my mouth." Cornell had wanted to be in the recording business so the cancer hit him hard. "I had to learn to enunciate again." He struggled to regain enough of his voice to be able to sing or even talk. "I had to leave college and move back home. Between the time I left college, and the time I finished radiation treatment for the cancer, my insurance coverage under my mom's policy ended. I was 23, and I had aged out. I was forced to take a job that I didn't want to take."

So, instead of beginning a career in the recording business, Cornell found a job that offered full health insurance benefits working in the A&P grocery company's warehouse. "One of the union stewards noticed my limp and told me that the company would pay 100% for the surgery if I worked there for one year. So, I stuck it out for a year." Towards the end of Cornell's year of service with A&P, he went to his primary care physician, Dr. Ronald P. Hairston. "The doctor who also brought me into this world," Cornell adds. "I asked him for a referral for a hip replacement doctor. He told me, the

best place on the East Coast was the Anderson Clinic! That's where I met Dr. Charles Engh."

Bad News Makes Good

But Cornell's high expectations weren't met at first. During Cornell's initial visit at the Anderson Clinic, Dr. Charles brought in all his assistants. "I thought, okay, here is my savior." But his hopes were soon dashed. "Dr. Charles told me he wasn't going to give me the surgery." Dr. Engh told Cornell they could try some different medicines or maybe fuse his hip. "But he didn't want to give me the hip replacement surgery because I worked in a warehouse. I was fuming when I left there!" While Cornell thought about his meeting with Dr. Charles repeatedly, trying to understand why Dr. Charles wouldn't give him the surgery, he candidly shares, "That was the best thing that ever happened to me!"

Later that same week, Cornell decided to return to Dr. Charles and ask him again. He was almost chanting to himself, "I have to see him. I must see him! He has to do the surgery!" When Cornell returned for a second appointment, Dr. Charles sat down with him and explained why he wouldn't do the surgery. Cornell was young and had a physically demanding job. The polyethylene liner in his hip replacement would likely wear at a high rate and lead to bone loss called osteolysis. The combination of wear and osteolysis might lead to multiple revision surgeries over his lifetime that would become increasingly complex. "If you go to school and get some other type of training, and then come back and see me, I'll consider giving you the surgery," Dr. Charles said.

"If I was angry before, I can't even describe how angry I felt. I was so mad at him!" As Cornell left the Anderson Clinic, he thought to himself, "Don't be my father, do the surgery! I have a father!" But even though Cornell felt angry, he was spurred to action by Dr. Charles' request for him to change careers.

Cornell Reddon attributes much of his success to Dr. Charles Engh's guidance and the personal interest he took in Cornell's life.

Cornell went to a nearby learning and trade center called TESST College of Technology. He met with a career counselor who suggested he take training to become an Office Automation Specialist. It was 1994 and Microsoft was just beginning its explosive growth. The program ran through January 1995. Cornell graduated at the top of his class. "Because I excelled in the course, TESST offered me a job. But as soon as I obtained the certificate, I made an appointment with Dr. Engh. When I showed him the certificate, he scheduled my surgery for the following week."

Cornell was 24 years old when he had his hip replacement. For his implant components, Dr. Charles used a porous-coated cup and stem to obtain long-term biologic fixation via bone ingrowth coupled with a ceramic head to try to reduce the wear of Cornell's polyethylene liner.

"I love Dr. Charles Engh. He saw me. He made it possible for me to be able to feed my family and get a great job. Because this man said, 'I won't do the surgery,' he literally changed the course of my entire life. All the knowledge and experience I've gained in my work and in my personal businesses, I owe to him. He knew there was something more to life than just walking. Walking is great, but realizing your full potential is even better. Dr. Charles helped put me on a new path that forever changed my life for the better."

Success and Education

As Cornell shares his story, he points out that life is going well for him. He momentarily reminds himself aloud, "If I hadn't used my brain instead of my brawn, I would not be where I am today. Education

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matters!" Cornell shares that he is currently working on a degree in communication through American Public University.

Pursuing his long-standing desire to be in the music industry, Cornell started a business called Legacy Worldwide in 2002. The business, based in Washington, DC, serves the management, production and publishing needs of musicians and creative artists in the entertainment field. Cornell shared that his company currently represents R&B artist O'Bryan. Through his business, Cornell has had the opportunity to meet many accomplished artists including Larry Blackmon and Tomi Jenkins of the band Cameo as well as the late Maurice "Moe" White, founder and lead singer of Earth, Wind & Fire. "I wouldn't have gotten involved with any of them unless Dr. Charles pushed me." On top of all of that, Cornell is an accomplished author. His book, titled *Dig Deep Before You Leap,* has scored 5.5 out of 6 stars on Amazon.

The Engh Standard

Cornell relates that due to the way Dr. Charles treated him, "I created for myself something I call *The Engh Standard*. *The Engh Standard* is higher than the gold standard. Gold is tied to money but Engh is tied to humanity. For me the standard guides my every decision. I ask myself during a decision-making process, 'Is this the most expedient thing to do or the right thing to do?' I apply it to everything I do. I always hearken back to what he did for me. He didn't have to care about me as a human being. He could have just wanted to make money. And for a young African American kid, Dr. Charles struck me as someone who took a personal interest in people."

As Cornell reflects on his life's lessons, he recalls his encounter with Dr. Charles Engh and his *fortunate* hip replacement. "In society, people of certain types can choose sides against those who are different from them. Without positive role models, we can remain locked in those patterns. I'll never forget Dr. Engh's treatment of me. He was a positive role model."

"*The Engh Standard*, is a way of life for me. I use it personally and professionally." As Cornell shares, his voice swells with emotion. He explains that Dr. Charles taught him how to view others as Dr. Charles viewed him. "I see the humanity of a person. I don't see their economic situation, or their color. If for any reason, I find myself drifting over to that lane of expediency, I remember Dr. Charles and how he saw me."

Hip Replacement Wearing Well

Though Cornell Reddon dreamed of a football career, a series of unexpected adversities led him to an encounter with Dr. Charles Engh who helped him discover a brighter future than he originally imagined. In January, Cornell celebrated his 15th anniversary with Pepco, where he currently works as a Credit Analyst. To summarize, Cornell repeats his gratefulness to Dr. Charles, "I wouldn't even have this job if it wasn't for Dr. Engh."

Since Dr. Charles has retired, Cornell goes to see Dr. Andy Engh, Dr. Charles' son, for follow-up. "With Dr. Andy, I see his genuine care for people too." At his most recent check-up, "Dr. Andy and I looked over the x-ray and, it still looks good. Whatever he tells me to do that is what I am going to do." Now more than 20 years after his surgery, we are delighted to report that Cornell's original hip replacement continues to serve him well and his polyethylene liner shows minimal wear.

Do you have a story you would like to share with the readers of the Joint Journal or a question you would like to ask? Please contact Susan Sensi at (703) 619-4411 or email research@aori.org.

Ho Nguyen, Knee Replacement Patient, Resilient Survivor

By Renée Burkett

Thanks to his knee replacement, Ho Nguyen is a remarkably active individual who is constantly on the go. When I caught up with him, he had arrived home only a few hours earlier from a seven-day trip. He was busy repacking his suitcase to leave the next morning and drive from the National Capital area to upstate New York to help care for his twin 18-month-old grandsons. He explained he would stay with them while his daughter-in-law was out of the country. At 71 years of age, Mr. Nguyen exclaims, "Thanks to Dr. Jerry, I am more active now than I have ever been in my life." Although his mobility was severely limited after he contracted polio at a very young age, Ho Nguyen has been making up for years of lost activity since his knee replacement surgery with Dr. Jerry Engh in March of 2010.

Ho Nguyen was born on July 15, 1946, in Vietnam. As he puts it, "I've survived *a few wars*." Perhaps Mr. Nguyen is speaking of more than just national wars, perhaps he is speaking of the war within to keep moving and living with incredible pain until he had his knee replacement.

As part of a year-long celebration of his 70th birthday, Ho Nguyen completed a 300-mile bike ride along the Rhine and Moselle Rivers in September of 2017. He is pictured in Koblenz, Germany, at the point where the Moselle River flows into the Rhine River.

A Rough Start But, New Vistas Open

To tell the story of his knee replacement, Ho Nguyen begins with his childhood. "In 1949, when I was barely three years old, the French came to our village on a search-and-destroy mission. It was during the First Indochina War, or Anti-French Resistance War (to us in Vietnam). My parents, my one-year-old sister and I were living in a small village in the northern part of Vietnam. The French soldiers came through our village. They were looking for resistance fighters. My parents were worried we would be found, so we hid neck-deep in a hyacinth pond from early morning until nightfall. The French soldiers would never stay until night so we waited until it was dark to return home. A few days later, both my sister and I contracted polio. Since polio is a communicable disease that can be spread by contact with contaminated water, my parents assumed we got it in the hyacinth pond while hiding. My sister died in a few weeks. The polio affected my right femur from the knee up to my hip. I could walk, but with quite a limp."

Ho was 14 when he came to the United States, "My mother and five of her children, including me, came

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to Monterey, California, in April 1961 to join my father there. My father left Vietnam in 1950 as a political refugee and ended up in Monterey in 1953, via Rome, Paris and Buffalo. All nine of the children eventually came to pursue education with the hope that we could return to Vietnam one day. However, the war prevented our return." Ho earned three degrees including a PhD, became a professor of mathematical economics at St. Mary's College of Maryland, married and had three children. "I have two boys, a girl and three grandkids. I think of myself as more active than most people, especially more active than most polio survivors." Ho explains how he used crutches or a cane to stay active. As a professor, he stood on his feet all day while trying to avoid the use of crutches so they would not interfere with his ability to write notes on the board. "It was incredibly painful, but I did it anyway."

Finding the Best Knee Replacement Surgeon

As he grew older, Ho's knee bowed outward and became quite deformed, a condition referred to as a severe varus deformity. It not only looked deformed, but it was also intensely painful owing to his severe arthritis. As he describes, "I was very much in pain most of my adult life." When Ho and his family would go on outings, he couldn't even carry his own camera. The lightest thing would have to be carried by his children or his wife. Despite this, he continued his active lifestyle. However, the tipping point that prompted Ho to decide he needed a knee replacement was the excruciating pain. During this time, Ho began to search for a knee replacement doctor. His quest led him to Dr. Gerard (Jerry) Engh. "I looked around and interviewed different surgeons. For me, the most important requirements were a surgeon that worked with polio victims and one who did nothing but knees. Dr. Jerry fulfilled both requirements." And, Dr. Jerry, being the consummate people person, not only replaced Ho's knee, but improved its appearance as well. "We never spoke about the shape of my leg, but Dr. Jerry reduced the bowing effect from polio when he did my knee replacement."

Before his knee replacement, Mr. Nguyen had always been extremely active but found sports that did not require leg strength. He sailed, canoed and kayaked. Once he was free from pain, he changed his activities to suit his new-found freedom. "Now I do activities that require leg strength. I motorcycle, I do whitewater kayaking, I do judo. I walk and ride my bike long distances."

Walking for His Sister

His newfound ability to walk without pain also spurred Ho to

Ho Nguyen takes a moment to relax in Fisterra, Spain, after completing his third Camino in August of 2016.

pursue new adventures. Three years after his knee replacement surgery, he decided to walk the Camino de Santiago, by way of the Camino Francés, a pilgrimage walk from St. Jean Pied-du-Port in France to Santiago de Compostela in Spain. He began his journey in April of 2013 and finished in May. He walked an average of 15-20 miles a day. Like many other walkers and pilgrims, Ho carried a backpack and walked seven to eight hours a day. Sometimes the road was steep, climbing into the Pyrenees, while other days it was flat. "I really want to say, when I walked my first Camino, the Camino Francés, I wasn't even

Ho Nguyen in Machu Picchu, a travel adventure that in his own words, "Would have been unthinkable!" prior to his right knee replacement with Dr. Jerry Engh in March of 2010.

sure I had the physical stamina to do it. I didn't even know if I could finish it."

The 500-mile journey took Ho only 35 days to complete. "I walked it for my sister who died from polio." While Ho speaks about his sister, his voice brims with emotion. In his mind, he is back in Vietnam, a young boy with his little sister by his side. His Camino gives her, in his heart, what she never had. "She never got to walk, so I did it for her."

A Year-long Celebration

In 2016, for his 70th birthday, Ho walked another Camino, the Camino Portugués, a 380-mile coastal route from Portugal to Santiago de Compostela. In between his two Caminos, in September of 2015, Ho went to Machu Picchu, Peru. "I went there five-and-a-half years after my knee surgery. Such a trip would have been unthinkable before the knee replacement!"

This year, Ho Nguyen has already completed another 250-mile hike from Porto, Portugal, to Fisterra, Spain. In January, he took a long-distance motorcycle trip in Vietnam. In May, he took a similar length motorcycle excursion in Nicaragua. This fall, he went to Germany to ride 300 miles along the Moselle and Rhine Rivers. In October, he trekked through Vietnam, Burma, Thailand and Cambodia. "None of this would have been possible without Dr. Jerry Engh's skillful hands."

A Final Word

As I finish talking with him, Ho exclaims, "Dr. Engh, he is a special guy. I am forever grateful to him. He changed my life. In the last seven years, I have done more physical activity than I did in the first 64. Dr. Jerry made it possible for me to do anything I want to do."

Thanks for Your Support

As we reflect on all the people who make our existence possible, everyone at AORI would like to express our sincere gratitude to those who have supported our research efforts. Each donation we receive enables us to undertake research that helps improve the quality of life for individuals who suffer from hip and knee arthritis.

Your donations and bequests go towards:

- The scientific assessment of new and existing implant systems
- The evaluation of new surgical procedures
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- The overall improvement of joint replacements

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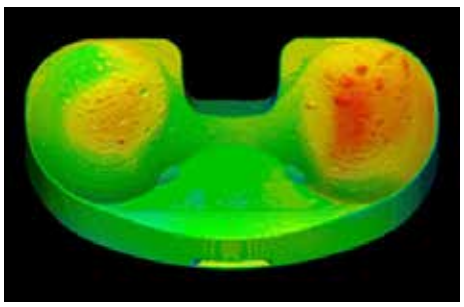


"Classic" Research Remains Relevant Years After Publication

"An extensively porous-coated stem that is bone ingrown will not loosen."

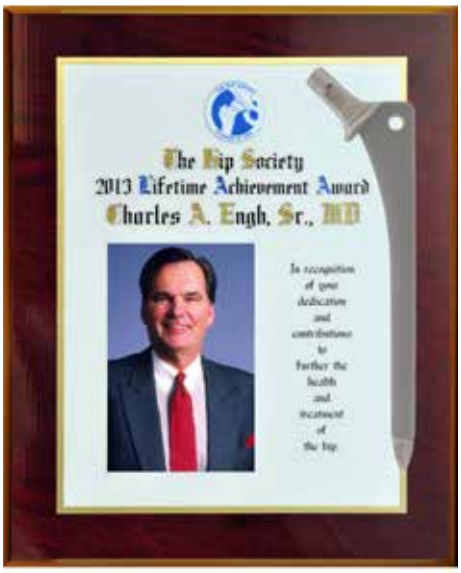
- Dr. Charles Engh

At AORI, we are proud of the enduring value of our research. By combining clinical data with observations from retrieved implants, we strive to understand the factors that contribute to the success and failure of joint replacement procedures. AORI's studies are often cited by other investigators and some of our research has come to be regarded as "classic" because of its long-standing importance to the orthopaedic community.

In an *OrthoBuzz* posting on June 5, 2017, Dr. Thomas W. Bauer, who serves as a Deputy Editor for *The Journal of Bone & Joint Surgery,* reflected on the importance of an article published 30 years ago by Dr. Charles Engh and his colleagues. Because investigating the mechanisms that affect the outcome of joint replacement implants and procedures has been a major focus of Dr. Bauer's career in orthopaedic pathology, he is uniquely qualified to comment on the impact of Dr. Charles' research that originally appeared in the January 1987 edition of *The Journal of Bone & Joint Surgery (British).*

While other investigators had previously reported observations about cementless implant fixation and bone remodeling before Dr. Charles published his research, Dr. Bauer notes that, "This study, which so far has been cited more than 1,500 times, goes 'above and beyond' by carefully correlating previous observations with histologic sections obtained through human femora." The study, titled "Porous-coated hip replacement. The factors governing bone ingrowth, stress shielding, and clinical results," reported the results from 307 patients after two years of follow-up and 89 patients after five years. It also included analyses of 11 porous-coated stems and the surrounding femoral bone that had been retrieved from patients after they passed away in conjunction with AORI's post-mortem implant retrieval program. Bone ingrowth was reported to occur in more than 90% of cases when a good press fit was achieved with the porous-coated stem filling the patient's femoral canal. Encouragingly, the fixation showed no deterioration over time.

Now three decades after the article was published, AORI is pleased to be able to report that porous-coated fixation via bone ingrowth remains durable. According to Robert Hopper, AORI's Executive Director, "Dr. Charles Engh always said that the porous-coated stems he used would never loosen when bone ingrowth was achieved. Consistent with his expectations, I am not aware of a single bone-ingrown stem that has ever loosened among the thousands of cases archived in AORI's database." You can read the full text of Dr. Charles' 1987 article at http://bjj.boneandjoint.org.uk/content/jbjsbr/69-B/1/45.full.pdf.



Recognizing the importance of his contributions, Dr. Charles received the Hip Society's Lifetime Achievement Award in 2013. An image of the extensively porous-coated stem he pioneered is superimposed on his award.

If you would like to make an online donation to AORI using PayPal, please go to www.aori.org and click on the word "Donate" at the top of the page.

Award Winning Research continued from page 1

biologic fixation via bone ingrowth offers the promise of permanent fixation, the wear debris from a hip replacement can lead to bone loss over time, known as osteolysis, that can compromise implant fixation and lead to fractures of the surrounding bone.

While attempts to perform hip replacements with different materials can be traced back to the early 1900s, the surgery did not become widespread until Dr. John Charnley introduced a type of plastic bearing surface known as ultra-high-molecular-weight polyethylene in the 1960s. Polyethylene is a rather simple material consisting of long chains of carbon atoms with two hydrogen atoms bonded to each carbon atom. Commonly known as "poly" in the orthopaedic community, the plastic bearing serves as an articulating surface between the femoral head and the metal shell implanted in a patient's pelvis. Historically, the average wear rate of most poly liners has been between 0.1 and 0.2 millimeters per year. Although this seems quite good knowing that most patients take a million or more steps each year, the femoral head can sometimes wear through the full thickness of the liner over many years and the accumulation of wear debris over time can lead to osteolysis. Because wear and osteolysis have been the most common reasons for long-term complications among hip replacement patients, there have been many attempts over the years to reduce wear by using a variety of materials including metals, ceramics and different formulations of polyethylene. While each new material was introduced with high expectations, conventional poly remained the gold standard based on its proven performance from the 1960s thru the late 1990s.

In the late 1990s, several manufacturers introduced cross-linked polyethylene liners for hip replacements. These liners consisted of conventional poly that was exposed to gamma radiation or an electron beam with enough energy to break the bonds between the carbon atoms within the long chain polyethylene molecules (consisting of several hundred thousand carbon atoms), allowing them to bond (or crosslink) with carbon atoms in adjacent chains. Although crosslinking reduced some of the polyethylene's material properties (like ultimate tensile strength and elongation to break), it improved wear performance based on laboratory studies. Nevertheless, owing to prior experience with materials that held great promise based on lab testing but delivered marginal clinical benefits, Dr. Charles and Dr. Andy wanted to evaluate the clinical impact of crosslinked polyethylene when they began to use it.

In January of 1999, AORI launched a clinical research study to evaluate how crosslinked polyethylene would perform in patients. During an 18-month period, 230 first-time hip replacements among 220 patients that included ten people who consented to have both their hips enrolled in the study were randomly assigned to receive either a conventional (non-crosslinked) poly liner or a crosslinked liner. The conventional liners were never exposed to radiation so they did not incorporate any crosslinking. Randomization was used to make sure the two groups were comparable and all patients in the study received the same type of cup, stem and femoral head. A total of 116 hip replacements got crosslinked liners while 114 were implanted with non-crosslinked liners. Polyethlene wear and osteolysis were measured from x-rays taken at follow-up visits. The cumulative incidence of revision was also evaluated by determining how many patients required additional surgery during the course of the study.

Since 1999, AORI has followed the patients in the study, periodically updating the results and publishing papers to share the outcome with the broader orthopaedic community. Five years after surgery, the patients with crosslinked poly demonstrated substantially less wear than the patients with conventional liners. By 10 years after surgery, the reduced wear resulted in less osteolysis. However, it remained uncertain whether the reduced wear rates associated with crosslinked poly had eliminated osteolysis or simply delayed its onset. Since the crosslinked poly was not quite as strong as the conventional polyethylene, there were concerns that the crosslinked liners might break over time. There were

also questions whether the crosslinked poly might deteriorate after many years of implantation, leading to increased wear rates at longer follow-up intervals. To address these questions and concerns, AORI evaluated the outcome of all study patients 15 years after their surgery.

After spending several years trying to follow-up with all the patients, AORI found that none of the patients with crosslinked liners had undergone revision operations for wear or osteolysis! In contrast, 17 of the patients with non-crosslinked poly required liner revisions for reasons related to wear. These 17 revisions occurred at an average of 12.3 years after surgery. At 15-year follow-up, the rate of revision due to wear and osteolysis was 12% for the non-crosslinked liners which was significantly higher than the 0% rate for the crosslinked liners. Among the hips that were revised and those that had at least 14-year follow-up, the wear rate was found to be substantially lower among the crosslinked liners (0.03 mm/yr versus 0.25 mm/yr). Reassuringly, there was also no evidence that the wear rate among the crosslinked liners was increasing over time and none of the liners in either group have broken. Among hips that had at least 14-year follow-up and did not require a revision, the incidence of clinically-important osteolysis (with an area on x-ray of at least 1.5 square centimeters) was significantly lower among the crosslinked group compared to the non-crosslinked group (2% versus 31%). Osteolysis of any size was noted among 9% (4/46) of the hips in the crosslinked group compared to 46% (18/39) of the hips in the non-crosslinked liner group. With low long-term wear rates and no evidence of osteolysis that threatens implant fixation, crosslinked poly combined with porous-coated fixation appears to represent a hip replacement that can last a lifetime, realizing Dr. Charles Engh's long-standing ambition to offer his patients a single surgery to solve their hip problems. While these findings bode well for the long-term performance of crosslinked liners, AORI plans to continue monitoring the patients in this study at 20-year follow-up and beyond.

Summarizing the research that he and his father have undertaken, Dr. Andy notes that, "AORI continues to be on the forefront of hip and knee replacement

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An early follow-up x-ray taken 1.3 years after a patient had their right hip replaced with a crosslinked liner and 1 year after their left was hip replaced with a non-crosslinked liner shows that the femoral heads are centered within the acetabular cups, demonstrating little wear.

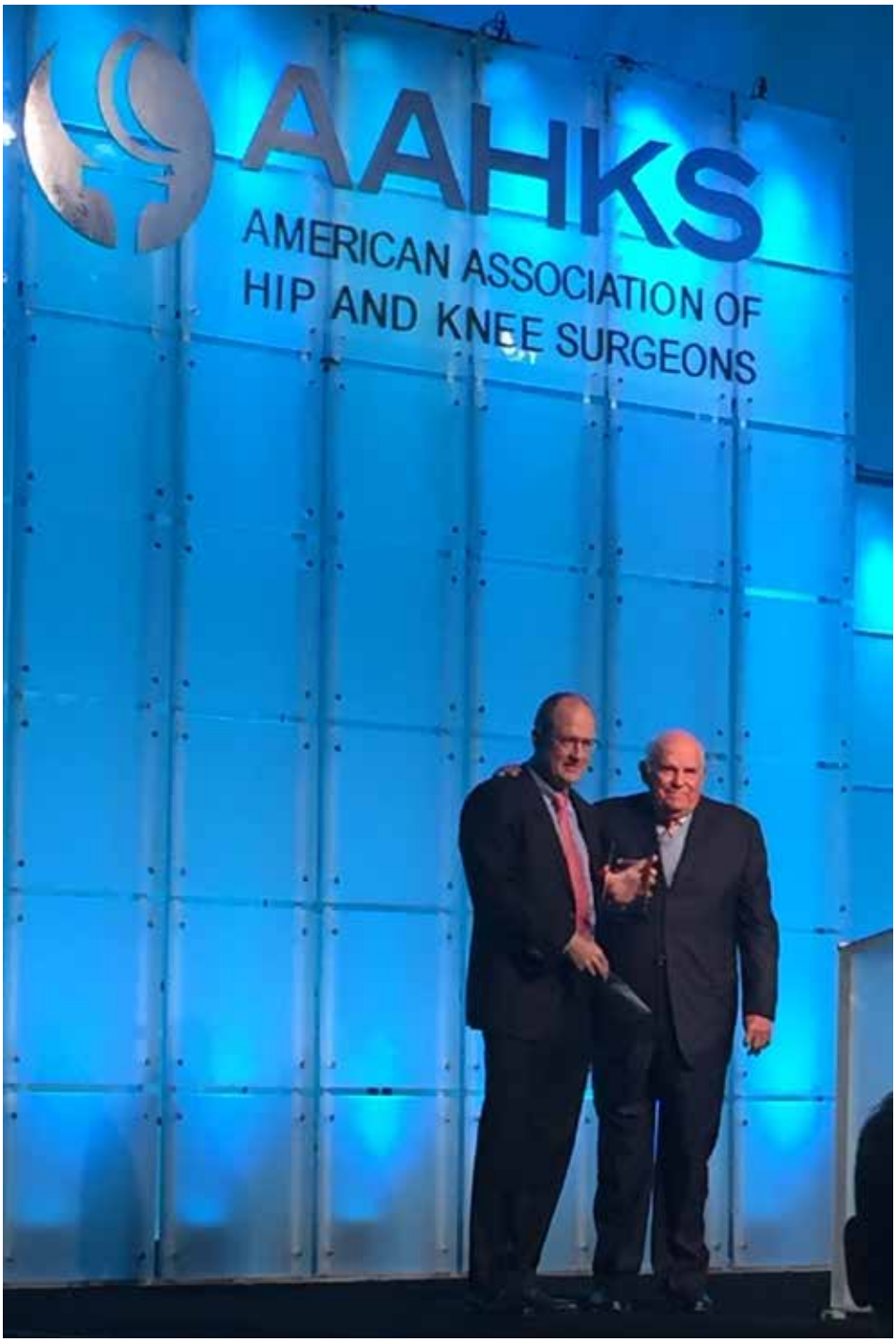
A follow-up x-ray of the same patient taken 12.2 years after their right hip replacement and 11.9 years after their left hip replacement demonstrates that the femoral head on the right side with the crosslinked liner remains centered while the femoral head on the left side is no longer centered within the cup. Osteolysis (bone loss) is also present on the medial (inner) side of the femur on the left. The patient's non-crosslinked liner and their 28-mm femoral head were revised 12.1 years after their original hip replacement using a crosslinked liner and a 36-mm head.

A follow-up x-ray of the same patient taken 16.4 years after their right hip replacement and 4 years after their left hip revision demonstrates that both femoral heads remain centered within the cups and the osteolysis on the left side has not progressed.

research. We adopted component fixation without cement in the 1980s and published results including 95% of hip implants working 20 years after they were placed. However, the problem was wear of the ball bearing. Our current study shows no reoperations for wear with crosslinked poly. We now know the plastic bearing that we began using in 1999 has the potential to last more than 20 years. The combination of pioneering reporting for prosthesis fixation and wear now allows an expected 20 years or more durability."

" We now know the plastic bearing that we began using in 1999 has the potential to last more than 20 years."

– Dr. Andy Engh



Dr. Bill Hamilton accepts his award from its namesake, Dr. Lawrence Dorr, at the 2017 AAHKS Meeting.

In contrast to Dr. Andy's prospective study where patients were enrolled to evaluate specific hypotheses and then followed according to a pre-defined plan, Dr. Hamilton's retrospective study looked back at the information accumulated in AORI's institutional database to address some contemporary concerns. Since the 1970s, AORI has been archiving hip and knee replacements in an electronic database. When patients return for follow-up, the information in the database is updated, allowing outcomes to be evaluated at short and long-term intervals. Maintenance of AORI's database requires a great deal of effort but the accumulated data can be an invaluable source of information.

As the number of patients requiring joint replacements continues to grow each year, there are concerns that the number of surgeons available to perform joint replacements may not meet future demands. While training more surgeons is one possibility, another option is to increase efficiency. Historically, joint replacement surgeons worked in a single operating room on a given day. Preparation of the room began before the patient

was brought in. After a patient's surgery was completed, the room was thoroughly disinfected and prepared for the next patient. This process required the surgeon to wait after completing one surgery before beginning the next. As a consequence, most surgeons were able to perform about three joint replacements during a typical day depending on the complexity of the cases. To improve efficiency, some surgeons have adopted the practice of using two rooms for surgery on the same day. At the Anderson Orthopaedic Institute, the use of the rooms is staggered so that the surgeon performs a joint replacement in one room while the other room is cleaned and prepared for the next patient. Once the surgeon completes the first case, they can go directly to the second room without waiting between cases. While this practice allows surgeons to perform six or more joint replacements in a single day, there have been some concerns that increasing surgical volume may compromise patient outcomes.

During the past 11 years, surgeons affiliated with AORI have done joint replacements in a single room on a given day (referred to as consecutive cases) or using two rooms (referred to as overlapping cases). Over that time, several surgeons transitioned from doing cases consecutively to doing most of their cases in an overlapping fashion. By drawing upon all of the first-time (primary) hip and knee replacements performed between 2006 and 2016, Dr. Hamilton's study sought to compare consecutive and overlapping cases to determine if there were any differences among the groups in revisions and complications during the first 90 days after surgery. Based on the information archived in the AORI's database, the study examined the outcome from joint replacements done by Dr. Charles Engh, Dr. Jerry Engh, Dr. Andy Engh, Dr. Kevin Fricka, Dr. Bill Hamilton and Dr. Nitin Goyal. The study found no difference in the incidence of revisions that involved exchanging an implant component within 90 days of surgery (both the consecutive and overlapping groups had revision rates less than 1%). There was also no difference in the rate of complications that did not require a component revision among the groups. While it will be important for other institutions to examine their own outcomes, the findings from AORI's database indicate that doing cases in an overlapping fashion (also called "running two rooms") can improve surgeon efficiency without compromising patient outcomes. Dr. Bill Hamilton presented this study at the November 2017 AAHKS Meeting in Dallas, Texas, where he was formally presented with the Dorr Award.

We deeply appreciate the time that all the doctors affiliated with AORI devote to research. While the doctors volunteer their time without receiving any financial compensation from the Institute, there is still a substantial cost associated with research studies. In an era where funding for the type of healthcare research that AORI conducts has been declining for several years, we are grateful to acknowledge that individual donors have stepped in to support AORI's research. In particular, Dr. Andy's award-winning research was supported by a gift from the estate of Jeanette L. "Jane" Blankenship, who had both her hips replaced by Dr. Charles Engh. During this holiday season, AORI would like to express gratitude to all of the individuals who make our research possible, from the doctors who design and oversee the studies, to the patients who participate and the donors who support our work financially. Without everyone's support, we could not continue our research. As it has for the past 45 years, AORI's enduring ambition is to seek answers to the most urgent clinical questions that joint replacement patients confront today. These questions are defined by the daily experiences of the orthopaedic surgeons who work with AORI and answered using thoughtfully designed studies based on clinical data from contemporary patients.

Dr. Andy's award-winning research was supported by a gift from Jeanette L. Blankenship.

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