



JOINT JOURNAL

VOLUME 25

WINTER 2015-16

Early Results from a Long-Term Study

When Dr. John Charnley revolutionized joint replacement in the 1960s, one of his most important innovations was the use of polymethyl methacrylate (PMMA) bone cement to bond the metal implant components to a patient's own bone. However, long-term follow-up studies over the next two decades demonstrated that the bone cement was often the weak link and its failure could lead to implant loosening. In response to concerns about the longevity of cemented components, Dr. Charles Engh began to implant hip replacements without cement in the late 1970s. During the 1980s, his research with the Anderson Orthopaedic Research Institute (AORI) demonstrated that bone would grow into porous metal implants, creating durable biologic fixation that can last a lifetime. Not long afterwards, other investigators began to use porous-coated implants for knee replacements. Unlike hips, however, the performance of early cementless knee components was generally inferior to components fixed with cement, particularly on the tibial side. While most cementless joint replacement components have historically been manufactured from a titanium or cobalt-chrome alloy, trabecular metal components made from tantalum were introduced more recently. These newer tantalum components feature porosity and mechanical properties that resemble those of a

patient's native trabecular bone. In addition, tantalum is biocompatible and chemically inert, making it resistant to corrosion and degradation when implanted within the body.

The potential benefits of knee implant fixation without cement include preservation of bone stock, shorter operating room time, ease of revision,



The underside of a cementless tibial component used for Dr. Fricka's study illustrates the porous trabecular metal surface that has a structure similar to human trabecular bone.

and the elimination of complications associated with cemented fixation, including third body wear and retained loose fragments. In the long-term, bone loss (osteolysis) patterns also tend to differ depending on the mode of fixation. Among cemented components, loosening on x-rays is usually preceded by the development of a progressively widening line at the cement–bone interface (called a linear radiolucency). In contrast, osteolysis associated with cementless implants typically demonstrates an expansile, balloon-like pattern in the bone adjacent to the implant that rarely interferes with component fixation.

As a consequence, polyethylene wear and osteolysis may be technically easier to treat when it develops in the presence of well-fixed cementless modular designs because bone grafting and a simple polyethylene liner exchange with retention of the metal implants might be possible instead of a revision procedure involving the metal components.

Celebrating the Career of Dr. Jerry Engh

Since the news of his retirement was publicized in the Summer 2014 edition of the *Joint Journal*, Dr. Jerry has been deeply touched by the many expressions of gratitude he has received! As we conclude our celebration of his professional career, we wanted to share a few more of the letters that have been received in this edition of the *Joint Journal*.

When Dr. Jerry began performing joint replacements, he did both hips and knees. As his career progressed, he focused more on knee replacements. When patients had progressive arthritis in both knees, he often replaced the more symptomatic knee first and the other knee later. In the following letter, John Jones, Jr., now 85 years of age, describes his experiences after Dr. Jerry replaced his left knee in 1997 and his right knee in 2004.

It has been over a decade now and I have not had any problems with the knees that were surgically replaced by Dr. Jerry Engh. At the time of my surgery, I had lived through pain in both knees for many years. Dr. Engh came into my life during a period when the pain was most severe and I could barely walk.

After visiting several other doctors, I had accepted my pain as a permanent part of my life. Then I came to see Dr. Engh and he immediately lifted my spirit. The explanations and reassurances he gave engendered my trust in him. From the very beginning, I felt comfortable and at peace with the explanations and treatment regimen he proposed. He was both reassuring and professional at each and every juncture. For the first time, I had hope that the knees which caused so much anguish and suffering might be repaired. Additionally, his staff was very professional and everyone was exceptionally kind and efficient. Of course, both surgeries were successful and today I am pain free in that part of my body. However, the story does not end there.

“I came to see Dr. Engh and he immediately lifted my spirit.”

It has been said that there is a good woman behind every good man. As I walked down the corridor after one of my appointments with the esteemed doctor, I met the exceptional woman in his life. Good is not an adequate description of this lady. In our single, brief meeting I observed qualities of integrity, kindness, and compassion as our conversation drifted as far away as the Bible. I came away thinking how privileged I had been to have met such a distinguished person.

In closing, Dr. Engh is a fantastic surgeon. He and his wonderful staff have made a big difference in my life. He has my heartfelt thanks for all he has done. Together, he and his wife make a very dynamic couple and I encourage them both to keep on doing good.

John W. Jones, Jr.

Celebrating the Career of Dr. Jerry Engh

Over the decades that he performed knee replacements, Dr. Jerry became an advocate of minimally invasive surgical techniques that retain as much of a patient's healthy tissue as possible. This often meant doing a unicompartmental knee replacement (also known as a "Uni") where only the arthritic portion of a knee joint is replaced and the rest of the healthier knee surfaces are retained. Having earned a reputation as a Uni specialist, patients were frequently referred to him and some people traveled substantial distances seeking his expertise. In the following letter, Gregory Erwin describes the pain relief he experienced and the activities that he has been able to do since having Unis implanted in both knees during a single surgery.

Dear Dr. Jerry,



Greg Erwin on the John Muir Trail in Yosemite National Park.

It is my pleasure for me to add my voice in thanking you for giving me back most of my knee mobility and ridding me of the constant pain associated with arthritis.

Prior to my bilateral knee replacement, I had several arthroscopic knee surgeries. As my knees continued to get worse, my orthopaedic surgeon in New York suggested that I have a consult with you. After my consult, it was decided that partial knee replacement was the best way to treat my knee problems. I had my surgery in November 2010.

During the summer of 2014, I was able to participate in a five-day hike in the high country in Yosemite National Park. It was a strenuous adventure for the entire group as we hiked for several hours each day with our packs and climbed to over 10,000 feet in elevation. This journey would not have been possible without having you as my surgeon and some can-do spirit on my part.

At times, I still have bad days, but in general, I'm now able to walk, take short hikes, bike and play golf without the excuse of having bad knees.

I join the hundreds of fortunate people who have had the privilege of having you as our surgeon.

With sincere gratitude,
Gregory J. Erwin

Celebrating the Career of Dr. Jerry Engh

In addition to caring for patients, Dr. Jerry devoted a substantial amount of time to research during his career. In the letter below, Debbie Ammeen, who began working with Dr. Jerry in 1985, and Nancy Parks, who began working with Dr. Jerry in 1992, recount their memories.

Dear Dr. Jerry:

We are happy for this opportunity to share our gratitude for the privilege of working with you over the years. We began doing research with you many years ago, shortly after our college graduation. You spent many hours teaching us about joint replacement and through your mentorship, we were able to grow with each project we worked on. As part of your research team, you encouraged us to share ideas and collaborate so that our work was the best it could be.

Working with you was like being part of a family. Just as in any family, we had challenging times such as abstract and manuscript deadlines (we both have some gray hairs to prove it), but we also had very rewarding times! Thank you for your patience with our questions when we had to "borrow" you from your clinic patients. We feel honored to have worked with you and shared many successful presentations, publications and awards. Between the two of us, we have worked with you for 44 years and counting... every completed study leads to another research question.

You have truly been a motivation to us in our work lives as well as in our personal lives. Both you and Patty demonstrated the importance of balance between family life and work life. You led by example with your children and transferred those values to our lives and the lives of our families. We appreciate that you allowed us to maintain our professional role at AORI, but were always understanding when we had a sick child or a school program to attend. Your and Patty's interest in our spouses and children have meant so much to us, and we are pretty sure you can still beat Nancy's husband, Keith, at tennis and run circles around Debbie's husband, Ed, on the basketball court. We are so glad we can still keep in touch with you both at the farm!

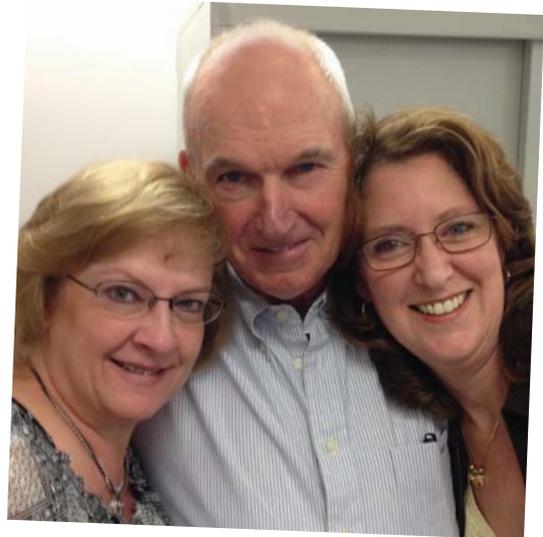
Continued

We also think we taught you a few things..... remember our very first Apple computer? ...The first knee database in dBase, 35 mm photography to create slides, x-ray films, literally cutting and pasting our abstracts into a box on a paper form and sending it via Fed Ex, and actual travel to collaborate on research projects. Nowadays, we "query" the database, use digital images and x-rays, upload the abstracts via the internet, and collaborate around the world with email. We can now reach you anytime via text on your cell phone. Amazing.....

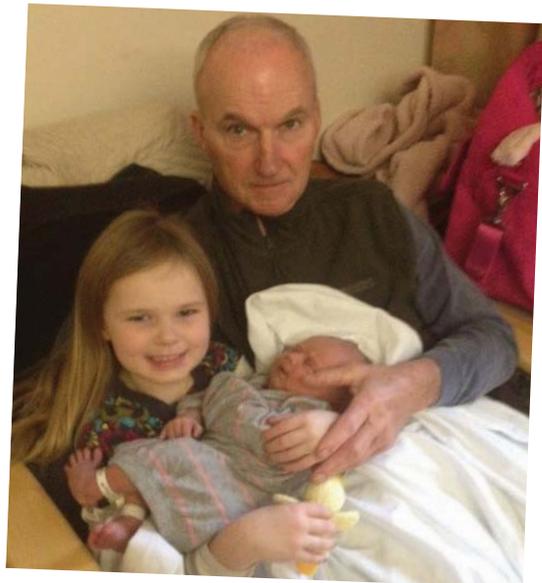
Despite all these changes, some things have stayed the same - you still have that twinkle in your eye and a kind word for anyone you meet.

In writing this letter to you and reminiscing about the years we worked together, we wanted you to know what an important part you hold in our lives. Without you, it would not have been as rewarding to do research for all these years. Thank you for everything!

Love,
Nancy and Debbie



Debbie Ammeen (left) and Nancy Parks (right) with Dr. Jerry Engh.



Dr. Jerry Engh welcomed his 14th grandchild, Cecelia, who was born on December 26, 2015. Cecelia's older sister, Evelyn, is also pictured. Both girls are daughters of Dr. Johnathan Engh, Dr. Jerry's youngest son, who is an Associate Professor of Neurosurgery at the University of Pittsburgh.

On behalf of everyone at AORI, we wish Dr. Jerry and Patty many years of joyous retirement.

More than Just a Job

Linda Cockrum's first job was with the National Orthopaedic Hospital in Arlington, Virginia. She began working in the Surgical Supplies department but was always looking for opportunities to take on more responsibilities. When her supervisor became aware of her ambitions and recognized her potential, Linda was moved into the surgical suite where she began a career as an operating room (OR) technician that would span four decades. Although the surgeon typically comes to mind when people think of what goes on in the operating room, it takes a team of skilled personnel to successfully execute complex procedures like joint replacements. Among the many people who comprise a joint replacement team, the OR technicians ensure that the whole process goes smoothly by preparing and quickly providing the surgeon with the tools and instruments needed to perform the procedure.

Over the course of her career, Linda worked with three generations of Engh surgeons. She started her OR career with Dr. Otto Engh, who founded the Anderson Clinic. When Dr. Charles joined the practice in the early 1970s, she began working with him and quickly became an essential part of his surgical team. In the course



Linda Cockrum with Dr. Andy Engh at the 2015 American Association of Orthopaedic Surgeons Meeting.

of pioneering the use of extensively porous-coated stems for hip replacements, Dr. Charles was frequently invited to other hospitals in the United States and around the world to demonstrate how to implant the components. When Dr. Charles went on these trips, Linda was always by his side, making sure that things were prepared prior to surgery and working side-by-side with him during the operation to ensure that everything went smoothly. Besides having a good implant system, Dr. Charles knew that having a skilled and well-educated surgical team was essential to a successful joint replacement. To make sure that his OR team stayed up-to-date on the

latest developments in orthopaedics, Dr. Charles frequently had Linda attend the Annual Meeting of the American Association of Orthopaedic Surgeons. At the meeting, Linda would hear about the latest developments in orthopaedics, including the results of Dr. Charles' own research work.

More than just her employer, Linda recalls that, "Dr. Charles always treated me like family. When my daughter came home from school with friends, he would always ask if we needed anything." In return, Linda was deeply devoted to Dr. Charles and wanted to help make him successful. Linda always loved her job



Dr. Charles Engh and his son, Dr. Andy, both worked with Linda Cockrum.

“Dr. Charles always treated me like family.”

– Linda Cockrum

and for those familiar with traffic in the Washington, DC metropolitan area, the fact that she commuted from Maryland across the Woodrow Wilson Bridge each day is a testament to her devotion. Even when she knew that traffic would be bad later in the day, she always remained in the OR until that last case had been completed. Recognizing that staff continuity was critical to maintaining success, Dr. Charles made sure that Linda accompanied him when he moved from the National Orthopaedic Hospital to the Inova

Mount Vernon Hospital in 1993.

As Dr. Charles neared retirement, Linda began doing more joint replacements with Dr. Andy Engh. Although it had not been an issue when she was younger, the surgical trays, which can weigh 30 to 45 pounds, seemed to become increasingly heavy over the years. Like many of the people she had helped treat, Linda also began to experience knee pain that became progressively more severe as she grew older. When she finally knew it was time to get



Linda visited Chichén Itzá on Mexico's Yucatán Peninsula and toured the Mayan ruins during the fall of 2015.

her own knee replaced, she chose to have Dr. Andy do her surgery in 2013. Although she was 69 years old at the time of her knee replacement, Linda returned to the OR and continued working until December of 2014 when she retired after more than 40 years of service.

Since retiring, Linda has remained active, going to the gym three days a week and volunteering at church whenever she can. Although the four children that she and her husband raised while she was working with the Engh family are now grown, Linda visits them as often as possible. She is also the proud grandmother of three grandsons, the youngest of whom will graduate from high school at the end of the current academic year. Together with all the people who have benefitted from Linda's exceptional skill and devotion to her job, we wish her many more years of well-earned retirement.

Persevering with a Passion for Life

Michèle Hélène Tuchschnid was born on January 28, 1926, in Argenteuil, a suburb of Paris, France. Although Michèle's father, Bruno, was a successful businessman, he had a hereditary neurological disorder known as Charcot-Marie-Tooth disease that affects the peripheral nerves in the limbs. While her father was only mildly impaired, Michèle was not so lucky. As a teenager, her feet became so crippled that she could not put her heels down and tended to fall. Fortunately, an excellent surgeon operated on her feet and legs so that she regained the ability to walk quite well. Yet before she could undergo physical therapy, the Germans invaded France. The occupation brought several years of hardship that included the death



Michèle upon arrival to the United States in August 1950.

of Michèle's mother. Fortunately, Michèle had an extraordinary grandmother who provided maternal support and imbued her with a passion for life. With a cheerful disposition evidenced by a quick smile and a spontaneity derived from her grandmother, few people were aware of the adversity that Michèle faced and she never complained about her plight.

Michèle met her husband, Bruce Wayne Shumway, after the war while he was studying statistics and physical chemistry at Sorbonne University in Paris. In the course of searching for someone to help improve his French, a woman in the building where Bruce was living introduced him to Michèle. Although she had always lived in France, Michèle's father, who had emigrated from Switzerland to the United States as a young man before returning to Europe, made certain that his daughter learned English. Smitten at first sight, Bruce subsequently pursued opportunities to practice his French with Michèle as frequently as possible. After meeting in many cafes over the course of several months, Michèle and Bruce were married by the mayor of Argenteuil in 1950.

When Bruce was offered the opportunity to return to the University of California's Laboratory of Experimental Oncology as a



Michèle and Bruce Shumway on their April 6, 1950 wedding day in Argenteuil, France.

Biophysicist, the newlyweds moved to the United States and initially settled in San Francisco. Over the next 25 years, Bruce pursued a professional career that included medical research related to cancer and radiological defense. During the course of his career, the couple moved from California to Maryland before Bruce retired in the mid-1970s. Although he enjoyed the stimulating work environment that his professional career provided, Bruce treasured the time he and

Michèle were able to enjoy as a couple. Whether spending time in the mountains or near the beach in Maryland, Florida, or South Carolina, Michèle and Bruce were inseparable during retirement.

Over the years, Michèle experienced gradually increasing pain in her right hip that eventually became debilitating. When she visited Dr. Jerry Engh in December of 1987, Michèle was using a cane and could walk less than a block. Diagnosed with advanced arthritis, Dr. Jerry replaced her right hip in February of 1988 using porous-coated implants pioneered at the Anderson Orthopaedic Institute. Although Michèle suffered an ischemic episode in conjunction with her surgery that required several days in the Intensive Care Unit, she recovered a pain-free range of motion and regained the ability to lead a normal life. Michèle was particularly proud of the fact that she was able to use a riding mower to cut more than an acre of lawn at the home that she and Bruce shared. Unfortunately, her ability to use the mower and engage in other activities gradually became more restricted as her other hip deteriorated. Although she and Bruce contemplated another hip replacement, they ultimately considered it too risky owing to the ischemia Michèle had previously experienced. Despite deteriorating vision and progression of her Charcot-Marie-Tooth disease that led to gradual loss of function in

both hands and eventual wheelchair confinement, Michèle never lost her zest and passion for life.

When Michèle passed at age 87, she left a legacy of generosity. Throughout her life, she was devoted to wildlife and the protection of wilderness areas. Michèle and Bruce also contributed to numerous charities, including the Anderson Orthopaedic Research Institute (AORI), and set up a foundation to protect animal life and to provide scholarships for bright young people. Everyone at AORI is deeply grateful for the Shumways' generosity and we will strive to use their gifts to improve the quality of joint replacements for all patients. Although Michèle's hip replacement lasted 25 years, her experience underscores that a successful joint replacement entails more than implanting a durable prosthesis. As implants have become more reliable, optimizing other aspects of the operation, from anesthesia to pain management and post-operative rehabilitation, has become more important. Although AORI continues to undertake research related to specific types of implants, we are now examining all aspects of the procedure, from length of stay in the hospital and short-term complications in the months following a joint replacement to long-term complications that can occur many years after surgery. Inspired by Michèle Shumway's example, we will strive to persevere and overcome the unexpected challenges that research sometimes presents, always with the same grace and tenacity that Michèle demonstrated throughout her life.

Despite adversity, Michèle never lost her zest and passion for life.



Michèle, an avid gardener, pictured in the garden outside her South San Francisco home in 1955.



Michèle and Bruce enjoy a ride to the top of Crockett Mountain on the Skylift in Gatlinburg, Tennessee.



Michèle and Bruce in 2001 during their retirement years.

Getting Better with Age

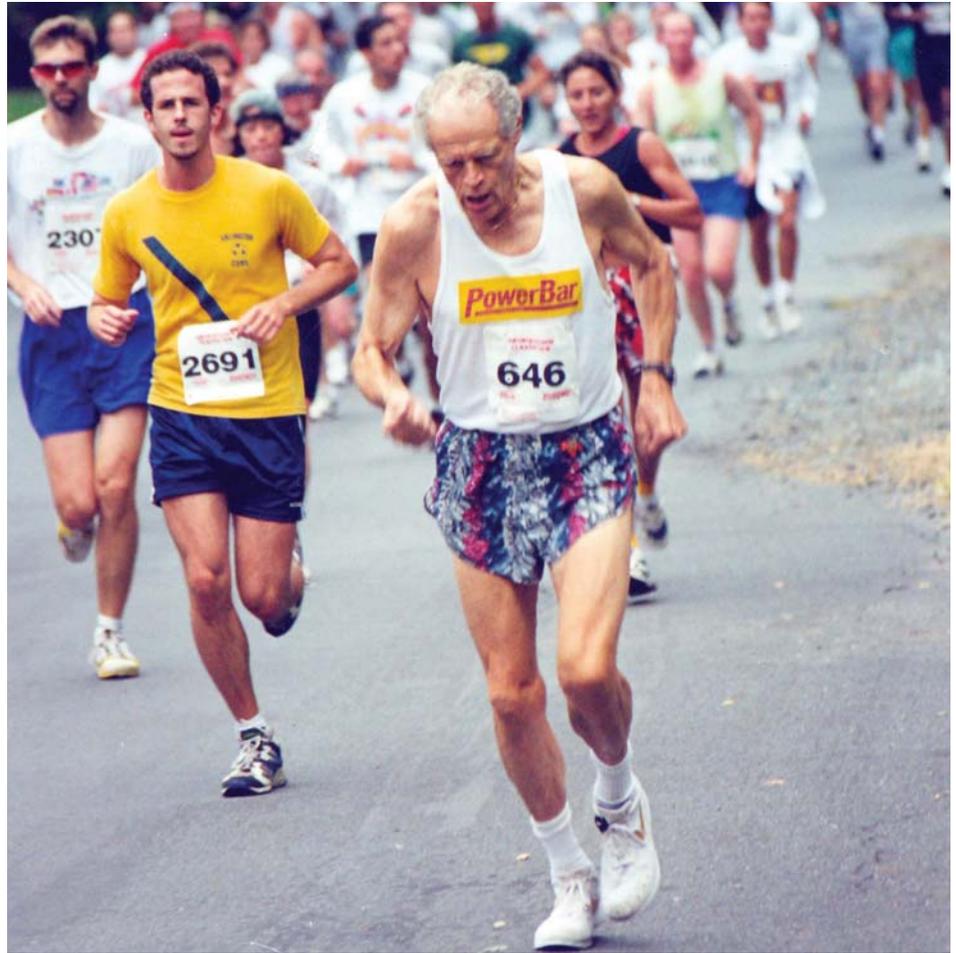
The story of every joint replacement patient is unique and Dixon Hemphill is remarkable in many regards. At an age when many people might be content to sit in a rocking chair, Dixon is setting world records on the track. Currently 91 years old, he holds the 2015 world record for the fastest 5000 meter in his age group with a time of 47:01 set at the Cherry Blossom 5K in Washington, DC, on April 12, 2015. He also holds world records for the 1500 meter and mile and is ranked in the top 10 for the 200 meter, 400 meter and 800 meter distances. In addition to his individual records, Dixon has participated on teams that have set world records. As part of the Potomac Valley Track Club's M90 relay team, Dixon and three other teammates set world records in both the 4x400 meter relay (12:54.81) and the 4x800 meter relay (29:47.68) at the March 2015 National Masters Indoor Track & Field Championships in Winston-Salem, North Carolina.

Dixon's running success may be even more remarkable knowing that he did not take up competitive racing until midlife. Although he had always been active, Dixon focused on field events during high school and college, competing in the pole vault, high jump

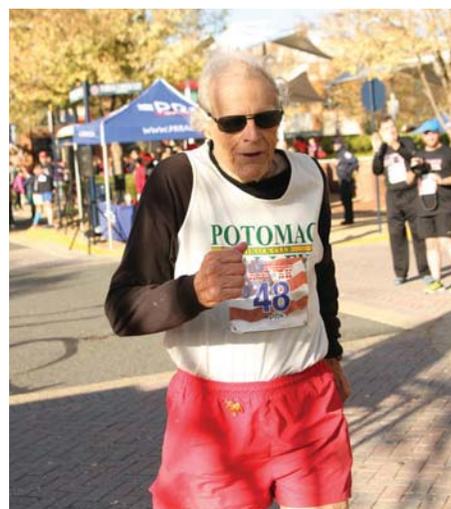


Dixon Hemphill with Dr. Andy Engh at a routine follow-up visit for Dixon's hip replacement.

and discus. It was not until much later in life, at the age of 50, when Dixon took up competitive running and began racing in local events. As his times improved, he graduated to competing at the national level including several long distance races at the National Masters during the 1980s. Not content to just run, he also began to compete in triathlons in his late 50s, participating in over 60 races between 1984 and 1998, including a first age-group place in the USTS Bud-Lite National Triathlon Championship held in Las Vegas, Nevada. Tragically, Dixon's athletic career almost ended in 1999 at the age of 74 when he was struck by a car while biking. With broken ribs, a collapsed lung and a pelvic fracture on his left side that had to be surgically reconstructed, Dixon's doctors thought he might never run again. Yet despite a post-operative staph infection that kept him hospitalized for 41 days, Dixon's passion for running motivated his recovery and he competed in his first 5K just eight months after his cycling accident. He continued to race into his early 80s with no plans to retire until hip pain began to slow him down. Although he had fractured his left hip in 1999, it was his right hip that developed osteoarthritis. As his right hip pain became progressively worse and nonsteroidal anti-inflammatories provided only minimal relief, he began to explore treatment options knowing that he wanted to find a surgeon who did a lot of hip replacements. An acquaintance recommended the Anderson Orthopaedic Institute and when he learned that Dr. Andy Engh



Halfway through the March 1995 Shamrock Marathon in Virginia Beach, Dixon runs with many competitors half his age. He placed 1st in the 70-74 age-group with a 3:44 time that qualified him for the Boston Marathon.



At the age of 90 and almost 8 years after his hip replacement, Dixon ran the Veterans 5K in Fairfax, Virginia, on November 8, 2015. As he completed the 3.1 mile course, a large crowd at the finish line cheered him on as the oldest competitor in the race.



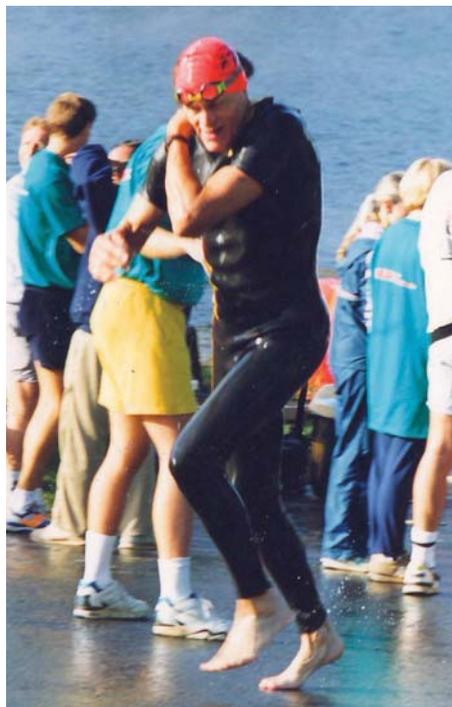
Dixon finishes the run in the September 1993 Reston Triathlon where he placed first in the 65-69 age-group.

was relatively young and shared his passion for sailing, he decided to have his hip evaluated. X-rays showed advanced degenerative arthritis of Dixon's right hip and Dr. Andy replaced his hip in February of 2008 using cementless components and a cross-linked polyethylene liner. Based on AORI's research, cross-linked polyethylene has proven to have a much lower wear rate than any type of polyethylene liner previously available.

While Dixon initially took it easy after his hip replacement, he gradually returned to competitive racing. Now 8 years after his hip replacement, Dixon shows no signs of slowing down. In fact, having taken 2 minutes off his 2014 5K time in the 2015 Cherry Blossom race, he appears to be getting faster with age! When asked what has contributed to his longevity and robust health, Dixon credits a good diet, regular exercise and a positive outlook on life. Besides running as a competitor, Dixon has coached other runners and directed many races. For over 20 years, he has hosted the Goblin Gallop (www.goblingallop.org), a family-friendly 5K event that supports families of children with cancer. In addition to running, Dixon's other interests include sailing and woodworking. He and his wife of over 60 years also enjoy the company of their four children and nine grandchildren who all live within 50 miles of their home. With confidence that his hip replacement will offer many more years of reliable service, we wish Dixon continued success, both on and off the track.



Photographed during the 25 mile bike segment of the 1988 Bud-Lite Triathlon in Hilton Head, South Carolina, Dixon finished the race and placed 1st in the 60-64 age-group.



Dixon emerges from the water after completing the swim in the 1984 Bud-Lite National Triathlon Championship in Las Vegas where he placed 1st in the 55-59 age-group.



Dixon celebrates his 1st place finish in the 70-74 age-group at the 1995 Army Ten Miler awards ceremony.

Early Results continued from page 1

With the goal of evaluating the clinical outcome of cementless total knee replacement using a modular trabecular metal tibial component made from tantalum, Dr. Kevin Fricka began to enroll patients in a prospective, randomized study in May of 2010. A prospective study involves careful planning in advance to control for potential confounding factors, enrolling individuals who consent to participate and assigning them to different treatment groups to examine very specific research questions. Although prospective research studies can take years to complete, they offer the highest level of scientific evidence. In this case, the ambition of Dr. Fricka's study is to evaluate results at 2, 5, 10 and 15-year follow-up intervals. In the short term, the outcome of cemented and cementless components was expected to be similar. In the long term, the cementless components might offer improved fixation since loosening continues to be a leading cause of revision among cemented knee replacements.

In February of 2012, Dr. Fricka completed the enrollment of 100 patients, all of whom were under the age of 75 at surgery. To eliminate the potential for bias regarding which type of implant a study participant received, patients were randomly assigned to groups in a one-to-one ratio so that a total of 50 would receive cemented knees and 50 would receive cementless knee replacements. To control for

other potential variables, all the implants for both groups were made by the same manufacturer and all patients had the same surgical approach, received the same type of polyethylene insert and the same post-operative management.

Because prospective studies have strict criteria for including and excluding patients, some of which may need to be evaluated at the time of surgery, being assigned to a particular group before surgery does not mean that a participant will always remain in that group. If the doctor determines that a particular treatment strategy should not be pursued because the patient does not meet the inclusion and exclusion criteria that need to be evaluated during surgery, a participant might be withdrawn from a study or receive a different type of treatment. Because cementless knee replacements require good bone for ingrowth, Dr. Fricka assessed the bone quality of each patient who he was planning to treat with a cementless implant.

At the time of surgery, one patient assigned to the cementless knee group had poor bone quality and was treated with a cemented knee. In addition, two other patients in the cementless group had a thin layer of cement added to the tibial side due to bone quality considerations in order to supplement the cementless fixation achieved with the trabecular metal pegs. As expected, surgical time for the cementless components was slightly less on average (74 versus

81 minutes) because Dr. Fricka did not have to wait for the cement to cure when he used the cementless implants.

After completing enrollment, getting follow-up for as many participants as possible is often the most challenging part of a research study. For this study, there were three patients in the cemented group and one in the cementless group who did not have 2-year follow-up and were considered lost. There was also 1 patient in each group who required a revision operation within 2 years of their knee replacement. Excluding these two revised patients as well as the one patient in the cementless group who was withdrawn from the study during surgery due to poor bone quality and the four patients lost to follow-up, there were 93 patients who completed minimum 2-year follow-up, including 46 in the cemented group and 47 in the cementless group.

Although there was only one revision in each group, the reasons for the revisions were different. The cementless revision was due to instability associated with a gradual change in the position of the tibial component over time and was related to implant fixation. In contrast, the one revision in the cemented group was due to infection and was not considered to be related to fixation. Although the cemented knees had no revisions related to fixation failures at

2-year follow-up, there were two manipulations for stiffness. These cases required no further surgical intervention but there were no manipulations among the cementless knees.

To understand how an implant is fixed to a patient's bone, x-rays provide valuable information. Ideally, the texture of the bone around the implant is uniform on an x-ray and similar to normal bone. When bone resorbs around the implant, it becomes easier for the x-ray beam to penetrate this region and it shows up slightly darker on an x-ray image. These darker areas are called radiolucencies. If an implant moves relative to the bone on successive x-ray images, this motion is called subsidence. Although there were no radiolucencies or subsidence noted in the cemented group at 2-year follow-up, 15% (7/47) of the cementless modular tibial trays had evidence of radiolucencies on x-rays with four demonstrating 3 degrees of subsidence, on average, and three others demonstrating stable radiolucencies with no subsidence. Including both the femoral and tibial sides, 23% of the patients with cementless components had radiolucencies between the implant and their bone. Although these radiolucencies did not progress between the time of surgery and 2-year follow-up, they will warrant continued observation in the future.

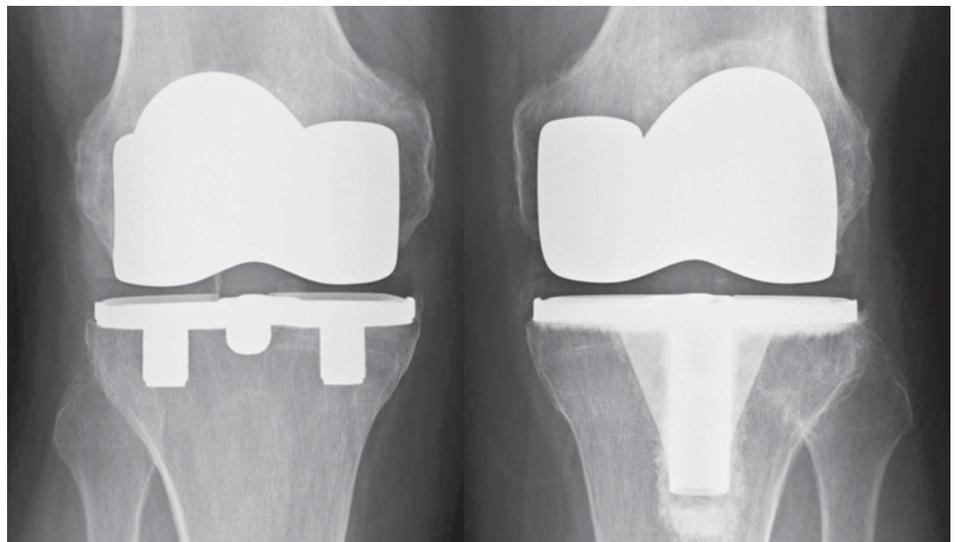
At 2-year follow-up, patient satisfaction rates were high (>95%) for both groups and at least 98% of patients reported less pain and

better function. While there was no difference in pain at 2 years, there was a tendency for the patients in the cementless group to have slightly higher pain scores at 4-month follow-up. A potential reason for this finding may be that it requires several months for bone ingrowth to occur with stabilization of the subtle micro-motion between the cementless porous implants and the patient's own bone.

In addition to reoperations and x-ray evaluation, joint replacement outcome scores combine several pieces of data to characterize how a patient is doing overall. For this study, several outcome scores were evaluated including the clinical and functional Knee Society Scores (KSS). While the functional KSS incorporates stair-climbing ability, the distance a patient can walk and the type

of support required while walking, the clinical KSS includes components for knee pain, range of motion, stability and alignment. With a maximum value of 100, higher KSS scores represent better outcome. At 2-year follow-up, the outcome scores for both groups were similar with the exception of the clinical KSS that had a 4 point difference with the cemented group averaging 96.4 versus 92.3 for the cementless group. Although this difference was statistically significant, indicating that it was not likely due to chance, both groups had average scores greater than 90 which represents a good to excellent result.

To get his personal insights, we caught up with Dr. Fricka and asked him a few questions about his research and its practical implications.



X-rays taken 2 years after surgery illustrate well-fixed implants without evidence of radiolucencies. The knee replacement on the right side of the image used cement to bond the implants to bone as evidenced by the whiter layer between the tibial component and the patient's bone. The knee replacement on the left side of the image used cementless implants and the patient's bone is in direct contact with the porous trabecular metal surface on the underside of the tibial component.



Dr. Kevin Fricka reviews a knee x-ray in clinic.

For a patient who is considering a knee replacement, what is the take home message from this study? The verdict is still out. Both cemented and cementless knee replacements had very good outcomes. If there is an advantage to cementless fixation, it will only become apparent with longer follow-up.

Given that long-term fixation is the goal, this 2-year follow-up study should be interpreted as preliminary findings. The plan is to continue to evaluate these patients at 5, 10 and 15-year follow-up as failures of fixation can occur both early and late after knee replacement.

At this point in the study, do you have any concerns about cementless fixation in knees? Cementless fixation may have patient limits. We intentionally excluded patients over age 75 from the study because of concerns about their bone quality but one patient randomized to cementless implants was still withdrawn from the study

during surgery and implanted with a cemented knee replacement due to poor bone quality.

There was more tibial subsidence in the cementless group but some early migration may occur when an implant is not directly bonded to a patient's bone with cement at the time of surgery. A limited amount of early migration has been previously reported with other cementless knee designs and radiolucencies have also been reported with cementless hip implants, but these findings typically do not cause problems if they are not progressive. With continued follow-up, I definitely want to find out how early subsidence and radiolucencies affect long-term outcome.

Did you find anything unexpected during this study? We were not expecting to see slightly higher pain scores 4 months after surgery in the cementless group. This may be due to bone remodeling as the patient's bone grows into the porous implant surfaces.

What's the biggest challenge you expect to face as you extend the follow-up for this study to 5, 10 and 15 years? The hardest thing is getting patients to return for follow-up, particularly as they grow older. For a high quality study, you typically don't want to have more than 10% of the patients lost to follow-up. We only had 4% (4/100) lost to follow-up at 2 years but it's going to take a lot of work to keep that number under 10% as time progresses. Knowing that it can be a challenge, we are always grateful when patients are willing to return for follow-up.

What type of components are you using in your practice right now? Since cemented components have a proven track record and the cementless implants did not have better outcome at 2-year follow-up, I currently use cemented components for almost all patients. Cementless knee implants are an option for younger patients with excellent bone quality who are interested in fixation without cement.

Are there any final thoughts you would like to share with the readers of the *Joint Journal*? I would like to be able to tell people that one option is clearly superior to the other. At this point however, the evidence indicates that the outcomes for both groups are very similar. I am looking forward to continuing this research so we can share the long-term outcome of this study with patients and the broader orthopaedic community. In the meantime, I'm glad that we were able to publish the 2-year results from this study in the September 2015 edition of the *Journal of Arthroplasty*.

ANDERSON ORTHOPAEDIC RESEARCH INSTITUTE

JOINT JOURNAL

P.O. Box 7088
Alexandria, Virginia 22307

Prsrt First Class
U.S. Postage
PAID
Lutherville, MD
Permit No. 171

*The **Joint Journal** is published by Drs. C. Engh, G. Engh, C. Anderson Engh, K. Fricka, W. Hamilton, and N. Goyal for the friends of the Anderson Orthopaedic Research Institute (AORI). Its contents are not intended as a substitute for medical advice.*

Editors & Writers:

Robert Hopper
Susan Sensi

AORI:
703-619-4411
Research@auri.org

**Anderson
Orthopaedic Clinic:**
703-892-6500

We hope you enjoy reading about AORI's joint replacement research, but if you prefer that we remove you from the Joint Journal mailing list, please complete this form and mail it to us at:

AORI
P.O. Box 7088
Alexandria, VA 22307

Name (please print) _____

Mailing Address _____

City, State, Zip _____

Thank you.