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AORI Improves Ability to Evaluate Knee Replacements

AORI's knee researchers have developed a technique enabling investigators to answer elusive questions about the amount and location of wear that occurs with different types of knee replacement components.

It comes down to geometry and motion when evaluating the performance of different joint replacement components. Hip

replacement components have an easy geometry. They consist of a spherical ball and a cup containing a polyethylene liner. An orthopaedist can calculate liner wear by looking at x-rays of a total

hip replacement and measuring how much the ball has worn down into the socket. Knees are another matter. They slide, rotate, and roll. Given these complexities, determining wear from a single x-ray is no easy task.

For this reason, knee researchers have resorted to studying polyethylene inserts retrieved during knee revision surgeries. By weighing the retrieved inserts, they can determine how much polyethylene has been lost. By inspecting their surfaces for damage,

they can learn about wear patterns. What they have *not* been able to measure accurately is the *volume* of polyethylene worn away from *different areas* of an insert. At least not until now.



Study co-authors Dr. Andy Engh and Robert Hopper display AORI's new method for evaluating wear in knee replacements.

ing volumetric wear lay in building three-dimensional (3D) images, or virtual models, of knee inserts. Starting with micro-computed tomography (microCT) images of knee inserts, AORI's knee team used imaging software to reconstruct 3D images of the inserts "cube by cube." As with the pixels that comprise digital pictures, the more cubes in a 3D reconstruction and the smaller they are, the better the model's accuracy.

See *New Research Technique*, page 7

Thank You! We've Reached Goal # 1!

We thank AORI's many supporters for helping us realize the initial goal of our Joint Legacy Campaign.

As we celebrate the 40th anniversary of AORI's founding, we are grateful to know we can count on the continuing support of people like you. When we launched AORI's Joint Legacy Campaign in December 2010, our goal was to raise \$2 million in donations and estate planning gifts. Thanks to the generosity of many, we are on our way to ensuring that AORI will continue providing answers to key questions for years to come.

See page 4, for the last letters being printed in tribute to the career of Dr. Charles Engh. There could have been no better tribute than the heartfelt letters sent to and read by Dr. Charles.

Interview with Dr. Andy Engh:

A Father's Legacy

At one time or another, many of us reflect on how the different aspects of our lives have touched others. Our personal and professional lives can seem worlds apart, yet, inevitably, they overlap. For Dr. Charles Engh, the intersection of his personal and professional lives was profound. Although surgeons with "Anderson" for a middle name no longer comprise the majority of partners at the Anderson Clinic, for several decades the clinic was a family busi-



ness. Dr. Charles began his own practice by joining his father. He worked with his brother, Dr. Jerry Engh, throughout his career and was

joined by his own son, Dr. Andy Engh, for 21 years – both at the Anderson Clinic and on multiple research studies at AORI. As we conclude our series of articles on Dr. Charles Engh's legacy, we asked Dr. Andy Engh to

share reflections about his father.

Q. What are the most important things you learned from your father in relation to your career?

I was lucky to be able to work with Dad for 21 years. He was motivated to provide the best care he could for his patients. He constantly researched the outcomes of his surgical techniques and looked for ways to improve their outcomes.

Dad was also very positive with his patients. His confidence in the results made it easier for patients to entrust him with this major life-changing surgery. The way he communicated and made sure his patients understood about the surgery shaped my own patient interactions.

Q. What inspired you to go into orthopaedic surgery?

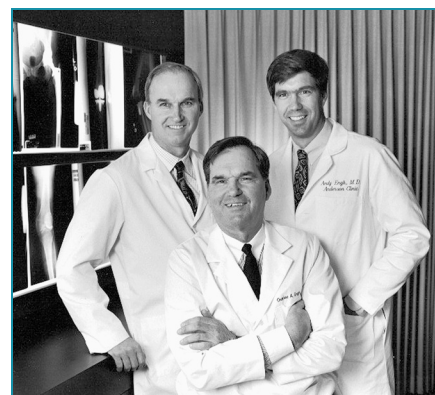
Dad was motivated and challenged by his work. He also enjoyed working with his father and with his brother, Dr. Jerry. Since I value the same things, becoming an orthopaedic surgeon was appealing.

When I started my practice, I liked seeing my grandfather's patients. Of course, seeing Dad's patients was exciting, and now that he has retired, caring for his patients is even more important to me.

Q. What are the most important aspects of your father's legacy to you?

Several things come to mind. First, there are the patients

Much has changed at AORI since this photo of Dr. Charles (front), Dr. Jerry (left), and Dr. Andy in the 1990s. We have several new physician researchers, Dr. Andy, now one of the "older" partners, has taken on AORI's leadership, and physicians now view x-rays on their computers.



whose lives Dad helped improve. I see this in the clinic each day when his patients tell me of their gratitude and their stories.

Another legacy, not necessarily in order of importance, is the research he did to prove that hip implants could be fixed to bone biologically (through bone ingrowth)

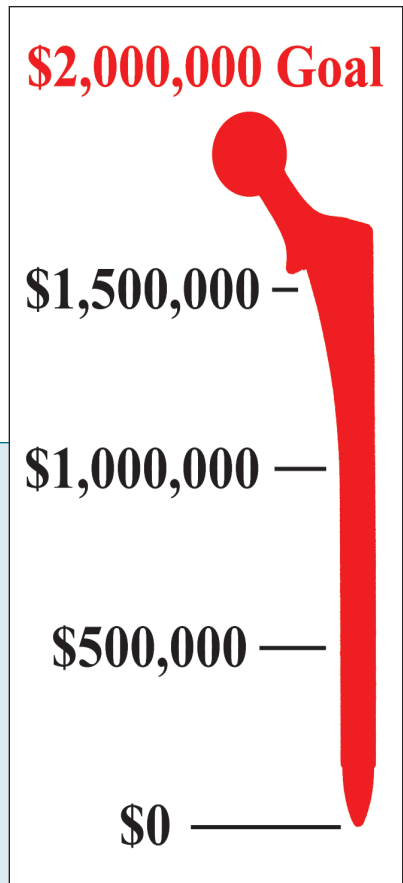
without cement. The testament to his years of research and his perseverance in disseminating his findings on porous-coated hip replacement is that almost 95% of the implants used today in the United States are done without cement.

His third legacy is AORI and

See Father's Legacy, page 6

Campaign Hits Its Goal

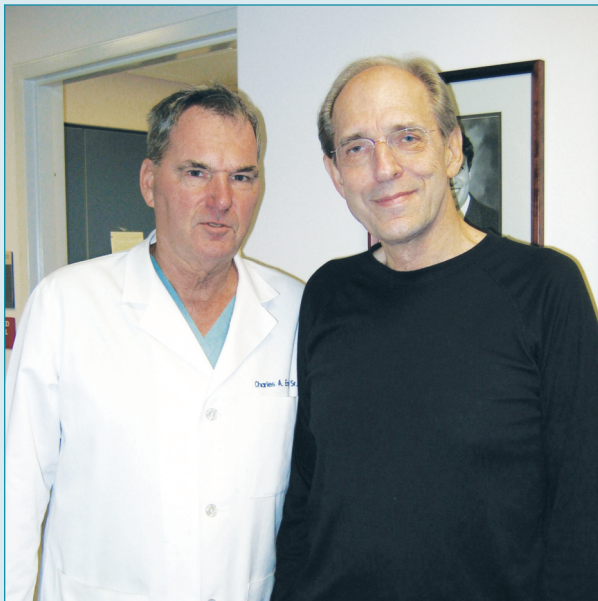
Thank you to AORI's many supporters for helping us reach our goal. The Joint Legacy Campaign for Pain-Free Movement has succeeded in laying a foundation for AORI's continued research efforts into the coming decade. Henry (Hank) Timnick, a hip replacement patient and ardent advocate of AORI's research, pushed our two-year campaign over the top. In the following letter, Hank shares his heartfelt reasons for supporting AORI with a generous estate planning gift.



The Healing Place

By Hank Timnick

I had my right hip replaced by Charles Engh in 1988, when I was 56. I was told many years before by two separate orthopedists that I would probably need a hip replacement sometime in my 50's. Since that was several years in the future, I had the opportunity to do thorough research on who the leading hip surgeons in the country were. I kept reading about Charles Engh and the ground breaking research taking place in Virginia at the institution known as AORI. I eventually went to see him, and in short order, I was certain that when I needed the surgery, when the pain became unbearable, no one in the country could surpass Dr. Engh's expertise.



over and hugged me, and said, "It's going to be great!" And out I went. That was powerful.

I WAS A DEDICATED PATIENT and followed the rehab

instructions to a "T." Not long after, I was mountain walking in Switzerland, something I had dreamed of doing for over a decade, and when I got to the top of this particular climb, I began to cry uncontrollably, unashamedly, in front of my friends. Tears of relief and joy. I now could do everything I wanted. I had always been athletic and was denied most of the sports I loved for so many years. Charles and AORI changed my life. I was young and vital once again.

To honor Charles and all his associates at AORI, I made a documentary that followed six patients of Charles and how they were faring, also doing the things in life that had been denied them for so long. It was called... *The Healing Place*. A very apt title.

AND THAT'S WHAT AORI IS ALL ABOUT. All the doctors and staff at AORI are there not only to renew hips, knees,

See *The Healing Place*, page 6

I will never forget the morning I was being pushed into the very cold operating theatre. Dr. Charles walked over to my gurney, flashed his infectious boyish grin, and bent

Letters of Joyful Tribute

What wonderful letters we have had the privilege of reading in the two years since Dr. Charles's retirement. Sent by patients, previous Fellows, healthcare associates, and international surgeons who performed research under Dr. Charles, the letters have spoken of changed lives, realized dreams, and eradicated pain. Dr. Charles has read and cherished each one. The following letter from Rosellen Mathey resonates with those of other young women and men who, suffering from congenital hip diseases, faced prospects of lives with limited, pain-filled movement just 30 years ago. Today, the fate of such young adults has changed due to research on porous-coated implants, the durability of components, and treatment outcomes. As in the case of Rosellen, fears of a life of dependence now can be transformed to experiences of joyful activity.

Dear Dr. Charles,

You are my hero, and I want to remind you of the difference you made in my life.

When I first met you, I was 28 years old, had undergone three hip surgeries as a child due to congenital problems, and my left hip had no cartilage to buffer the pain. I had been to several doctors who all gave me unacceptable solutions for a young woman who wanted to be independent. I was frightened at the prospect of having to move back to my parents' home because I could not care for myself. I was frustrated because I could not sit through my MBA night classes without excruciating pain. Exercising, something that had been my lifeline since my first surgery at age 11, was just too painful. You were the only doctor to give me hope, and you changed my life.

If you remember, I first met you early in the summer of 1981, and I told you that I wanted to be able to dance at my sister's wedding the next summer. My long-term goals were to be able to lead an independent life, to continue my career as an accountant

and complete my MBA coursework at night. In November 1981, you successfully replaced my left hip. And the new hip was so much better than



Rosellen Mathey, her husband Len, and their children Len, Jr., and Alison. Rosellen's hip replacement enabled her to keep up with very active children.

my birth hip. Yes, physical therapy was hard work, but it was worth it.

God used you to answer my prayers. Not only did I dance at my sister's wedding, I danced with my fiancé, Len. We married and were blessed with two lovely children, both

“You were the only doctor to give me hope, and you changed my life.”

with perfect hips that you examined. Alison, my oldest will be 27 in November — she was the first “porous-coated” baby. Her brother, Len Jr., arrived 22 months later. As much satisfaction as I received completing my MBA and working as an accountant, nothing compares to the joy I felt as my husband and I raised our children. I taught them how to swim, we went hiking, I sat through and helped at numerous scouting functions, T-ball, soccer, basketball, softball, volleyball, track, swimming, diving and martial arts competitions. Yes, God laughed and gave us one tom-boy (now a lovely lady who just completed a half iron-man) and one very active boy — no ballerina for me. They are both 6 feet tall and successful! Whenever I've come for my checkups, you've always hugged me and told me to bring a picture of my children, which I have done for the last 26 years.

I can never thank you enough for enabling me to achieve my goals.

Warm Regards,
Rosellen Mathey

The Game of A Lifetime

It all began when the principal came to Tom Wilkinson's third-grade class and said that anybody who wanted to learn to skate could get out of school early on Thursdays. Hands shot into the air. Shortly thereafter, Wilkinson was one of many students pushing a kitchen chair around the town's ice rink, learning the fine art of balancing on a thin blade.

Those first steps on the ice took place in the small town of Nelson in the British Columbia. Ironically, Wilkinson never played Canada's national winter sport until his family moved back to the United States on the outskirts of New York City. There, as a teenager he played hockey on the frozen ponds and in pick-up leagues at the rink where the New York Rangers practiced. He had found his life-long sport.

In the ensuing years at Dartmouth College, Wilkinson shot pucks with his fraternity brothers, even going so far as to sneak into the campus ice rink at midnight until the campus police paid them a visit. After finishing college and serving with the U.S. Navy, Wilkinson became a reporter in New York and gradually made his way to *The Washington Post*. With a political beat in Richmond, Virginia, hockey was out until he moved to the *Post's* office in Washington, D.C., where he once again joined pick-up games in area rinks.

ONE MIGHT THINK A SPORT LIKE ICE hockey would have age limitations, but not for die-hard players. In his



Tom Wilkinson with his grandchildren Ada and Owen Linde after a day at the rink with the Ashburn Oldtimers.

sixties, Wilkinson joined the Ashburn Oldtimers near his home in Loudoun, Virginia. In his 70s, he joined the Gerihatricks Senior Ice Hockey Club in Laurel, Maryland, formed by and for die-hard hockey players over 60.

Obviously, members of the Gerihatricks also have senses of humor, deriving their team name from the term "hat trick," when one player scores three goals in a game.

"When that happened in the olden days, people in the stands would take off their hats and throw them onto the ice," says Wilkinson. "It was a monumental achievement by one player."

SO TOO IS PLAYING COMPETITIVE hockey at age 70. To keep the game at speeds conducive to the players, Gerihatricks teams are organized by age groups — 50s, 60s, and 70s. Wilkinson noted some key exceptions

to this rule. The 70-year-old team can pick up a couple of players who are 68, or anyone 65 who is "bionic in any way."

That last rule seems an unfair advantage, especially when considering Wilkinson, who just months after a partial knee replacement can skim across the ice free of pain.

Having endured knee pain from arthritis for 15 years, Wilkinson would not consider knee surgery until the pain interfered with hockey.

"I was concerned I would lose the ability to play. It was the thing I could do that didn't hurt," he says.

Last year, when the pain invaded Wilkinson's hockey games, one of his team members, who was happy with his partial knee replacement, encouraged him to see Dr. Jerry Engh.

"I liked the option of a partial knee replacement, because the recovery time and damage would be less," says Wilkinson.

By the time Wilkinson saw Dr. Jerry, he also had pain in his right hip and back, but he was hopeful about the prognosis. He was a candidate for a partial knee replacement, and the hip and back pain were probably from compensating for the knee.

Calling his recovery "a terrific trip," Wilkinson says, "I was walking the next day with a cane. I did the exercises religiously and went to physical therapy."

Wilkinson is back on the ice for the 2012-2013 season. When speaking about his passion for ice hockey, the writer in him comes out.

"This is a game of great speed and fluid grace, of nimble athleticism and geometric precision. I go out to play, because I want to be around if anything like that ever happens when I'm there."

The Healing Place continued

and shoulders; it's also a place that heals one's spirits and gives back the zest for living and pursuing careers and vital avocations. It's a place that enables people to return to their families and work with a positive and enthusiastic attitude. Gone is the grimace of pain that contorted our tired and weary faces, and people say to us, "Wow, what happened? You look ten years younger!" Doesn't that sound familiar?

That's why in 2005 I travelled across the country from California to have my other hip replaced. I turned 80 in August, and everybody tells me I look in my 60's. Well, I

have to admit I chose my Renaissance Mom very carefully, as she lived with great joy until 108.

For all these reasons and more, I have been generous to AORI, donating more than \$120,000 to date, and have earmarked another \$2 million in my will to AORI. I want to see the good research work continue so that others will have better and better results in the days and years ahead. I hope that all of you who are reading this brief article will consider an annual gift and set something aside in your trust if you feel that you have been blessed by "The Healing Place" from all these phenomenal doctors, researchers and dedicated staff.

I want to see the good research work continue so that others will have better and better results in the days and years ahead.

Hank Timnick
Hip Replacement Patient
and AORI Supporter

If you would like to help support AORI's research or would like information about making an estate donation, please complete and return the envelope attached with this newsletter.

Father's Legacy continued

the long list of American and international doctors who have trained at our Institute.

Q. As you look towards AORI's future, what are your goals for the Institute?

From the time Dad helped found AORI, his vision was of an organization that would do world-class research and spread its results to the broader orthopaedic community. When it came time to review AORI's accomplishments each year, Dad's measure for success was not based on the balance statement but, rather, on the number of publications we had gener-

ated that year. I want to help AORI continue to realize my father's aspirations. The Institute needs to continue

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doing research with the highest standards of integrity.

Q. What other specific things will you undertake?

Dad's and Dr. Jerry's commitment to advancing surgical techniques and implant technology enabled AORI's

success. I hope to inspire my newer and younger partners in the Clinic in the way Dad and Dr. Jerry inspired me — that is not only to be able to care for our patients, but also to take what we learn from our research to improve joint replacements.

It is important that AORI maintain its status as a source for research publications that are recognized and used worldwide. To do that we must consider AORI's budget. I want to see the Institute become self-sustaining through my generation and the next generation of doctors.

New Research

Technique *continued*

“To get an inkling of the accuracy of our reconstructions, consider the diameter of a human hair. That is about the length of a cube used in our virtual models. There are about 40 million of these cubes in each reconstruction,” says Dr. Andy Engh, the study’s lead author.

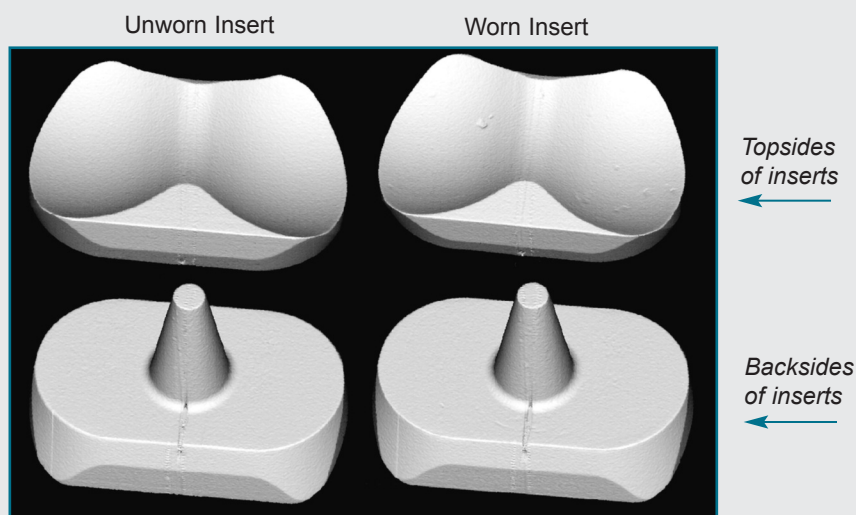
So what did our researchers do with these highly-accurate 3D reconstructions?

They used them to study the wear associated with two types of commonly used knee implants – the “fixed-bearing knee” and the “rotating platform knee.” By superimposing the images of a worn insert with an unworn insert of the same type, they determined the locations and volume of wear on the implants.

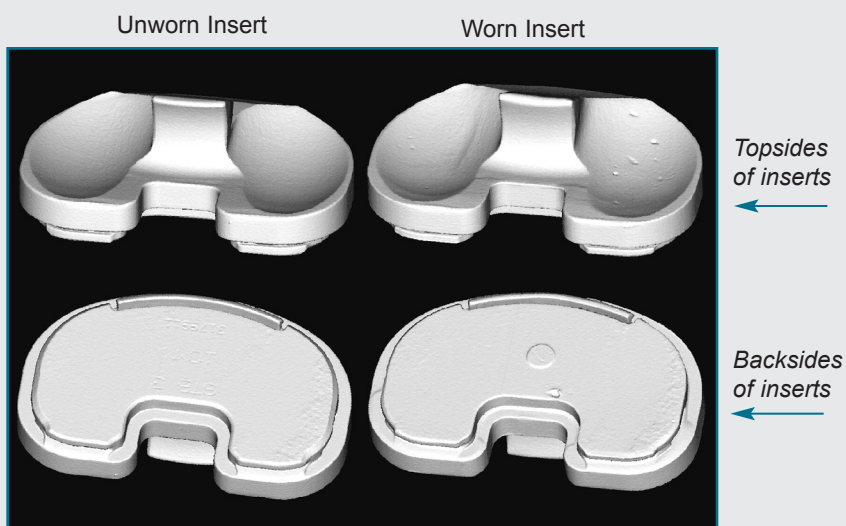
THE RESULTS SHOWED that both designs had fairly low annual wear rates after an average of 4.3 years *in-vivo*, but the average wear rate of the rotating platform inserts was *about 40% less* than the fixed-bearing knee wear rate. They also found that the rotating platform knees do not cause increased wear on the backsides of inserts, as some in the orthopaedic community had feared.

The 3D technique also has potential applications for laboratory simulations and clinical follow-up.

“One of AORI’s research goals is to evaluate whether measurements taken from routine follow-up x-rays can be related to the more accurate volumetric measurements obtained from retrieved implants. This could provide additional information to orthopaedists when determining the best ways to care for their knee replacement patients,” says Dr. Andy.



Using 3-dimensional images of the polyethylene inserts of knee replacement components, AORI’s researchers can pinpoint areas and volumes of wear. Above are reconstructions of inserts from rotating platform knee replacements. The central post on this component’s backside allows it to rotate on a metal tibial tray. A few small pits are visible on the topside of the worn insert (top right) in contrast to the unworn insert on the left. AORI’s results showed that rotating platforms tended to reduce wear on the backside of the inserts.



Above are reconstructed images of the polyethylene inserts from fixed-bearing knees. The insert of this component snaps into a metal tibial tray. Research shows that micromotion can occur between the insert and tray. This reconstruction reveals several small pits on the topside of the worn insert. The backside surface of the insert has been worn away, except for the circular area that had protruded into a hole on the tibial baseplate.

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Editors & Writers:

Rebecca Wolf
Robert Hopper
Susan Sensi

AORI:

703-619-4411
Research@aori.org

**Anderson
Orthopaedic Clinic:**

703-892-6500

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