CORE



ESTD 1969

UNMC

2018 REPORT

DEPARTMENT OF ORTHOPAEDIC
SURGERY AND REHABILITATION

AAOS Core Values:

LEADING TO SERVE

SHAPING OUR FUTURE

EXCELLENCE TOGETHER

UNMC Core Values:

INNOVATION

TEAMWORK

EXCELLENCE

ACCOUNTABILITY

COURAGE

HEALING

INSIDE

MISSION	**02 - 03**
MESSAGE FROM THE CHAIR	**04 - 05**
DEPARTMENT RESIDENCY PROGRAM	**06 - 07**
FACULTY	**08 - 13**
NEW FACULTY	**14 - 19**
NEW BUILDING	**20**
TOTAL HIP REPLACEMENT	**22 - 26**
KNEE TRANSPLANT	**28 - 32**
HAND & UPPER EXTREMITY SURGERY	**34 - 38**
RESEARCH	**40 - 51**
GRANTS, FUNDS & ENDOWMENTS	**52 - 53**
FEATURED DONORS	**54 - 55**
HONOR ROLL & WALL OF HONOR	**56 - 57**
MEET OUR RESIDENTS	**58 - 60**
POST-GRADUATES	**61**
EDUCATION	**62 - 63**
ALUMNI	**64 - 65**
VISITING SPEAKERS	**66 - 67**
FACULTY ACTIVITIES	**68 - 78**
OTHER FACULTY	**79**
NEWS	**80 - 82**
SCIENTIFIC ABSTRACTS	**83 - 106**

CORE

NOUN /KÔR/

The central or most important part of something

At the University of Nebraska Medical Center Department of Orthopaedic Surgery and Rehabilitation, our values form the core of everything we do. These principles set the standard for delivering excellence in patient healing, leading the field in innovative research and educating the orthopaedic surgeons of tomorrow.

This is our unwavering guide.

THIS IS OUR CORE.

CORE **MISSION**

The Department of Orthopaedic Surgery has always strived to be a local and national leader in orthopaedic care. Above all, our mission is to advance the future of orthopaedic medicine by providing state-of-the-art patient care, innovative education and cutting-edge research.

In academic medicine we often speak of our mission as a "three-legged stool," where each leg stands for a different aspect of our service and provides the basic framework of our practice. Each leg is vital for the success of not only the academic mission, but also the other two legs. Only by successfully integrating each of the three legs can we give patients the best possible care, educate the next generation of orthopaedic surgeons and develop top-notch procedures and techniques for the future.

PATIENT CARE

We specialize in the prevention, diagnosis and treatment of musculoskeletal disorders in children, adolescents and adults. Our service provides quality, cost-effective care in each of the orthopaedic subspecialties: adult reconstructive surgery, hand and upper extremity surgery, shoulder and elbow surgery, foot and ankle surgery, orthopaedic oncology, orthopaedic traumatology, spine surgery, sports medicine and pediatric orthopaedics.

EDUCATION

Our residency training program is a competitive, challenging program that equips residents with the very best tools and training. By investing in education we are not only creating tomorrow's top orthopaedic surgeons, but also cultivating promising educators who will teach for generations to come. Over the course of five years, our residents train in all nine orthopaedic specialties with rotations at Nebraska Medicine and other practices throughout the Omaha community.

RESEARCH

Through clinical outcomes studies and collaborative projects, our surgeons conduct world-class research in the areas of musculoskeletal diseases, molecular biology and genetics. At our Biomechanics and Advanced Surgical Technologies Laboratory, research faculty are dedicated to the development of less invasive surgical techniques, knee implant simulation and computer-aided robotic surgery.

MESSAGE
FROM THE CHAIR



Leading with Values

The Department of Orthopaedic Surgery at the University of Nebraska Medical Center has long been dedicated to our mission of improving the quality of orthopaedic care throughout Nebraska and beyond. The members of our department are committed to finding new ways of developing more advanced patient care, important breakthroughs in research and superior education of the next generation of orthopaedic surgeons. As part of this commitment, we are pleased to present our seventh biennial year-end report, *Core.*

As I look back on the past two years, they have clearly been pivotal in our department's history. Most encouraging, is how recent growth initiatives have supported our tripartite mission of patient care, education and research, while upholding and strengthening the values essential to our mission.

At the time of the last biennial report, the Lauritzen Outpatient Center and Fritch Surgery Center were still under construction. I am pleased to report that we have now been in this location for more than two years and its benefits have exceeded our expectations. From the outside, the state-of-the-art facility at 40th and Leavenworth streets is an impressive structure. More remarkable, is the high level of care and education we are able to provide on the inside.

Thanks to a generous donation from Ruth and Bill Scott, longtime supporters of UNMC and the Department of Orthopaedic Surgery, all facets of the department are now under one roof, including our academic department, outpatient clinic and Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory. This has been a tremendous gain in advancing collaboration among faculty, residents, research staff, and support and clinic personnel.

One of the great benefits of facility expansion has been a growth in our department personnel. In the past two years, we have added seven faculty members to our department: hand, wrist and upper extremity surgeon Daniel E. Firestone, M.D.; sports medicine and arthroscopic surgeon Katie L. Freeman, M.D.; pediatric orthopaedic surgeon Matthew A Halanski, M.D.; orthopaedic trauma surgeon Sara M. Putnam, M.D.; foot and ankle surgeon Alexander B. Sawatzke, M.D.; sports medicine and arthroscopic surgeon Matthew A. Tao, M.D.; and adult spine surgeon Scott A. Vincent, M.D.

These surgeons have brought enthusiasm and a high level of commitment to our patient care, education and research. One of Dr. Firestone's areas of special interest is complex fractures of the wrist, and he is involved in hand and wrist surgery implant design. Dr. Freeman and Dr. Tao have been driving forces in expanding the department's sports medicine program. In fact, in this report you will find a patient story about a meniscal transplant Dr. Tao performed here at UNMC. Dr. Freeman's arrival to our department has expanded our services to Bellevue, where she performs surgeries and holds clinic at Nebraska Medicine Bellevue. Dr. Putnam is a valuable addition to our orthopaedic trauma team. She particularly focuses on care of the polytraumatized patient, fractures near or involving joints, fractures of the pelvis and acetabulum, nonunions and malunions. Dr. Vincent, a 2016 graduate of our residency program, has helped us to expand adult spine services to the greater Nebraska community by holding bi-monthly clinics at Columbus Community Hospital in Columbus, Nebraska.

In 2015, we were approved for an additional orthopaedic resident each year, to bring our total complement to 25. It is exciting to be able to increase the number of future surgeons who come through our program. Our Nebraska Orthopaedic Residency Training Program continues to yield the brightest young orthopaedic surgeons, many of whom go on to build their careers in the Midwest–and even right here in our department. We had more than 560 applicants to our orthopaedic residency program in 2018 alone.

Our faculty members have always maintained the belief that, first and foremost, residents are here as learners rather than service providers. The Dr. Edwin Davis & Dorothy Balbach Davis Global Center for Advanced Interprofessional Learning is under construction on the UNMC campus, next to the Laurtizen Outpatient Building. The Davis Global Center is a highly advanced clinical simulation facility that will provide realistic replicated health care settings and foster patient care practice in interprofessional teams. This investment in next-generation technology for medical education, along with our proximity to Telemedicine services in the Lauritzen Outpatient Building, will provide even more value to our orthopaedic residents as they complete their residency training at UNMC.

As you'll see in the pages of this report, our faculty members have made unprecedented strides in furthering the field of orthopaedics through research, fellowship and collaboration. Since our previous edition of this report, our faculty members have produced 75 peer-reviewed journal articles and book chapters, given more than 130 presentations at local, regional, national and international conferences and institutions, and are currently involved in more than 50 research studies. It is an honor to have such significant work happening at UNMC. In particular, the department's Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory, led by director Hani Haider, Ph.D., is leading the pack in developing testing standards for orthopaedic implants, as well as revolutionary surgical tools that have the power to improve the lives of patients around the world.

This biennial report represents the culmination of two years of progress in the Department of Orthopaedic Surgery and Rehabilitation. My hope is that this publication serves as an update to our alumni, peers and friends of the department, who all make our successes possible through their motivation, collaboration and donation.

From all of us in the Department of Orthopaedic Surgery and Rehabilitation, thank you for your continued support.



Kevin L. Garvin, M.D.
Professor and Chair
Orthopaedic Surgery
and Rehabilitation

DEPARTMENT RESIDENCY PROGRAM **MARKS A HALF CENTURY**

A look back on the residency program's beginnings with Lowell Niebaum, M.D., the first graduating resident.

This year the Department of Orthopaedic Surgery celebrated the 50th anniversary of its residency program. Since its inception, more than 170 orthopaedic surgeons have graduated from the program and now practice throughout Nebraska and the U.S. The program was born with Lowell Niebaum, M.D., the department's first graduating resident. His path led him from Nebraska to across the globe and back to UNMC's inaugural resident class.

Dr. Niebaum, a native of Fremont, Nebraska, graduated from UNMC in 1962 and completed a Navy internship in Jacksonville, Florida. Looking to spend his three-year Navy commitment somewhere other than a ship, he transferred to Pensacola, Florida, for medical aviation training and then joined a Marine squadron. He worked as a Naval Flight Surgeon in a 1965 tour of Japan and then spent time in Vietnam and at the Navy Auxiliary Landing Field in Monterey, California.

After his time in the Navy, Dr. Niebaum began a general surgery residency at Orange County Medical Center, which became the University of California Irvine that year. When hopes to join their newly formed orthopaedic residency program didn't work out, he pursued a search for an orthopaedic residency.

"On a visit to my parents' home in Fremont in the fall of 1968 I paid a visit to UNMC to visit with dear friends and teachers, Dr. Harry McFadden, a pathologist and reader of my senior thesis, and Dr. Merle M. Musselman, chief of surgery," Dr. Niebaum recalls.

"They each asked me about my future plans and I told them I was looking for an orthopaedic residency. They said 'why don't you do it here' and I said 'because you don't have one,' And they both said 'yes, but we're going to start one.' "

They encouraged him to contact Thomas Hood, M.D., who was appointed by the Board of Regents as associate professor and chairman of the Orthopaedic Department in 1967. Dr. Hood was planning an orthopaedic residency program and already had a resident, Max Jardon, M.D., lined up to start in January 1969. Dr. Niebaum was accepted into the program and started in January at the second-year level.

"Max had been in general practice in Loop City and I had been a physician in the military world," Dr. Niebaum said. "I think they felt that both of us could be trusted to speak up and contribute and mould things as best we could. The early days were an adventure. There was some exploring and pioneering to determine who should be where and doing what."

As the inaugural residents, Dr. Niebaum and Dr. Jardon played important roles in helping to set the direction for the program, including forming journal clubs and weekly conferences. Initially, these were at UNMC and Methodist Hospital, but as the number of residents grew so did the variety of rotations. As a U.S. Navy veteran, rotating at the VA was among Dr. Niebaum's residency highlights.

Collaboration with Creighton University School of Medicine and the Nebraska Orthopedic Society bolstered residents' educational opportunities. Dr. Niebaum recalls spending numerous hours in the anatomy lab.

His comprehensive training at UNMC helped prepare him to perform a wide range of orthopaedic surgeries during his 40-year career, with a focus on total joint replacements during the latter part of his career.

Pioneering was not only a part of Dr. Niebaum's residency, but also his career. After graduating from the department's residency program, he moved to Las Vegas and joined two orthopaedic surgeons who were looking for a partner. They then joined two other orthopods and formed the Desert Orthopaedic Center, a practice that now has 24 surgeons at four locations. He recalls that Las Vegas only had 10 orthopaedic surgeons when he moved to the city in the early 1970s. Today, the bustling city has a medical school and an orthopaedic residency program.

Dr. Niebaum retired seven years ago, but has maintained his medical license and is still a regular at Nevada Orthopaedic Society meetings and checks in at Desert Orthopaedic Center regularly. He also stays busy attending shows in Las Vegas, visiting his three children in California and Texas, and enjoying his new title of 'grandpa.'

He reflects on his time at the Orthopaedic Residency at UNMC, "It was indeed a leap of faith."



FACULTY

Adult Reconstructive Surgery



Curtis W. Hartman, M.D.
Associate Professor
Adult Reconstructive Surgery

Kevin L. Garvin, M.D.
Professor and Chair
Adult Reconstructive Surgery

Beau S. Konigsberg, M.D.
Associate Professor
Adult Reconstructive Surgery

Shoulder & Elbow Surgery



Philipp N. Streubel, M.D.
Associate Professor
Hand and Upper Extremity Surgery, Shoulder and Elbow Surgery

Matthew J. Teusink, M.D.
Assistant Professor
Shoulder and Elbow Surgery

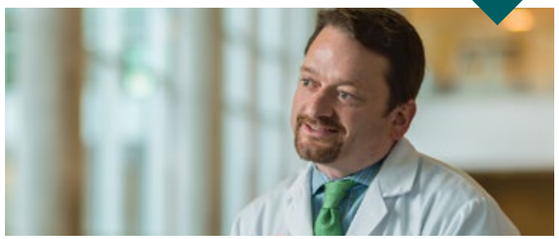
Adult Spine Surgery



Scott A. Vincent, M.D.
Assistant Professor
Adult Spine Surgery

Chris A. Cornett, M.D.
Associate Professor
Adult Spine Surgery

Orthopaedic Oncology



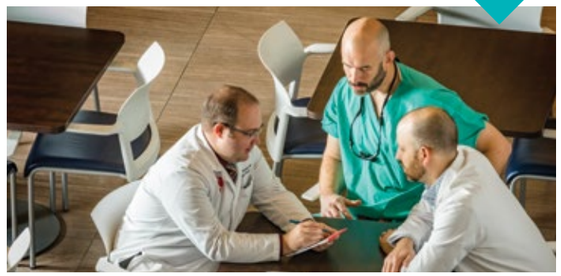
Sean V. McGarry, M.D.
Associate Professor
Musculoskeletal Oncology

Foot & Ankle Surgery



Alexander B. Sawatzke, M.D.
Assistant Professor
Foot and Ankle Surgery

Hand & Upper Extremity Surgery



Joseph A. Morgan. M.D.
Assistant Professor
Hand, Upper Extremity & Microvascular Surgery

Daniel E. Firestone, M.D.
Assistant Professor
Hand, Wrist & Upper Extremity Surgery

Philipp N. Streubel, M.D.
Associate Professor
Hand & Upper Extremity Surgery, Shoulder & Elbow Surgery

Pediatric Orthopaedic Surgery



Paul W. Esposito, M.D.
Professor
Pediatric Orthopaedic Surgery

Natalie C. Ronshaugen, M.D.
Assistant Professor, Pediatric Orthopaedic Surgery

Matthew A. Halanski, M.D.
Assistant Professor, Pediatric Orthopaedic Surgery

Susan A. Scherl, M.D.
Professor
Pediatric Orthopaedic Surgery

Brian P. Hasley, M.D.
Associate Professor
Pediatric Orthopaedic & Spine Surgery

Maegen J. Wallace, M.D.
Assistant Professor
Pediatric Orthopaedic Surgery

Kody Moffatt, M.D.
Adjunct Professor, Pediatric Orthopaedic Surgery

Sports Medicine



Matthew A. Tao, M.D.
Assistant Professor
Sports Medicine & Arthroscopic Surgery

Katie L. Freeman, M.D.
Assistant Professor
Sports Medicine & Arthroscopic Surgery

Matthew J. Teusink, M.D.
Assistant Professor
Shoulder and Elbow Surgery

Philipp N. Streubel, M.D.
Associate Professor
Hand & Upper Extremity Surgery, Shoulder & Elbow Surgery

Orthopaedic Traumatology



Sara M. Putnam, M.D.
Assistant Professor
Orthopaedic Traumatology

Matthew A. Mormino, M.D.
Professor
Orthopaedic Traumatology, Lower Extremity

Justin C. Siebler, M.D.
Associate Professor
Orthopaedic Traumatology

Research



Hani Haider, Ph.D.
Professor
Director, Orthopaedics Biomechanics & Advanced Surgical Technologies Laboratory

CLINICAL **FACULTY**

Adult Reconstructive Surgery

The department's adult reconstruction surgeons specialize in inflammatory, degenerative and post-traumatic joint problems; bone and soft tissue reconstruction; and prosthetic joint replacement. Our surgeons perform more than a thousand total knee and total hip arthroplasties every year, taking great measures to improve patients' outcomes.

Through important clinical research, we also play a role in the advancement of joint arthroplasties, corrective osteotomies, implants, biomaterials, and bone, cartilage and soft tissue treatment. Our practice is able to take advantage of translational biomechanics research and industry-leading testing of knee replacement implants.

Kevin L. Garvin, M.D.
Dr. Garvin has special interests in hip and knee reconstruction, and the prevention and treatment of musculoskeletal infections. He has maintained an active clinical practice, performing over 400 primary hip and knee arthroplasties and periacetabular or femoral osteotomies per year. He has extensive experience performing all hip approaches (anterior, anterolateral, transtrochanteric and posterior). He is also an active researcher, having published 150 peer-reviewed scientific articles and book chapters.

Curtis W. Hartman, M.D.
Dr. Hartman specializes in comprehensive care for adult patients with hip and knee arthritis. His other interests include revision of failed hip and knee replacements, as well as management of infected hip and knee replacements.

Beau S. Konigsberg, M.D.
Dr. Konigsberg specializes in comprehensive care for adult patients with hip and knee arthritis. His focus is on primary and complex hip and knee replacement and revision surgeries.

Adult Spine Surgery

The department's spine surgeons understand how debilitating back and neck pain can be. We provide comprehensive evaluation, treatment and management for a wide range of routine and complex conditions, involving all cervical, thoracic, lumbar and sacral aspects of the spine, including deformities, injuries and deterioration. We specialize in arthritis, spinal stenosis, tumors, trauma and other specialized treatments in adults; as well as various conditions that impact children, including scoliosis, hip dysplasia, sports injuries, limb deformity and trauma.

Chris A. Cornett, M.D.
Dr. Cornett's clinical expertise is in all aspects of adult spine surgery (cervical, thoracic, and lumbar). In his spine-only practice, Dr. Cornett treats a variety of conditions including degenerative conditions/arthritis, spinal stenosis, myelopathy, spondylolisthesis, disc herniations, instability, scoliosis, tumors and trauma.

Scott A. Vincent, M.D.
Dr. Vincent's expertise includes spine trauma, spinal cord injury, tumors of the spinal column and degenerative conditions of the cervical, thoracic and lumbar spine. His special interests also include less invasive surgical treatment options for spinal pathology.

Shoulder & Elbow Surgery

The department provides comprehensive evaluation and management for a wide range of shoulder and elbow disorders, including arthritis, dislocation or instability, fractures, rotator cuff and tendon tears, joint stiffness and complications due to previously unsuccessful surgeries. We use a multidisciplinary team approach to consider non-surgical and surgical treatment plans, ranging from exercises to full reconstructive operations, with a goal to maximize joint function.

Philipp N. Streubel, M.D.
Dr. Streubel specializes in comprehensive care of the upper extremity. His clinical interest focuses on degenerative conditions and traumatic and overuse injuries of the shoulder, elbow, wrist and hand. His research interests include shoulder arthroplasty and the treatment of elbow stiffness and instability, as well as management of thumb arthritis, wrist fractures and trauma of the proximal and distal humerus.

Matthew J. Teusink, M.D.
Dr. Teusink's clinical expertise is in shoulder and elbow replacement, fractures and arthroscopy. His special interests are reverse shoulder replacement, including revision shoulder replacements, as well as arthroscopic management of tendon and ligament tears around the shoulder.

Orthopaedic Traumatology

The department's trauma team specializes in evaluation, treatment and long-term follow-up of fractures, dislocations and other musculoskeletal injuries, ranging from common to complex. We use internal, intramedullary and external fixation techniques, as well as microvascular techniques for the repair of fractured joints and damaged soft tissues.

Nebraska Medicine offers a Level 1 trauma center that provides 24/7 trauma coverage for Omaha and the surrounding areas. Patients with polytrauma, long bone and/or pelvic trauma benefit from a comprehensive array of emergency services, diagnostic imaging and medical and surgical consultation. Our outpatient clinic is also available for long-term follow-up.

Matthew A. Mormino, M.D.
Dr. Mormino's special concentrations include pelvic fractures, malunions and nonunions, foot and ankle trauma, and periarticular fractures.

Sara M. Putnam, M.D.
Dr. Putnam specializes in orthopaedic fracture care, care of the polytraumatized patient, fractures near or involving joints (periarticular fractures), fractures of the pelvis and acetabulum, nonunions, and malunions. Additional research interests include studying how social support and access to care affect patient outcomes following trauma.

Justin C. Siebler, M.D.
Dr. Siebler's clinical expertise is in orthopaedic fractures, injury and trauma. He specializes in fractures in and around joints (periarticular fractures), fractures of the pelvis and hip socket, and fragility fractures.

CLINICAL **FACULTY**

Orthopaedic Oncology

UNMC's orthopaedic oncology team consists of a highly-skilled interdisciplinary team of surgeons, radiologists, pathologists, medical and radiation oncologists and allied health professionals. They treat patients for a variety of benign and malignant bone and soft tissue tumors and tumor-like conditions in all areas of the axial and appendicular skeleton. We emphasize a modern approach to surgical preservation of skeletal function, often with bone graft and custom prosthetic implants.

Sean V. McGarry, M.D.
Dr. McGarry specializes in orthopaedic oncology with a focus on limb salvage.

Pediatric Orthopaedic Surgery

The department's specialty-trained pediatric surgeons are dedicated to the care of all musculoskeletal problems in infants, children and adolescents at Nebraska Medicine and our pediatric partner, Children's Hospital & Medical Center. As the largest and most comprehensive pediatric orthopaedics team in the region, our physicians are fellowship-trained in both congenital and acquired orthopaedic conditions, many of which are unique to children.

We treat limb and spine deformities, including clubfeet, scoliosis and hip dislocations. We also treat patients for gait abnormalities, bone and joint infections and fractures and dislocations of the arms, legs and spine. Children with spina bifida, cerebral palsy, muscular dystrophy, osteogenesis imperfecta and other congenital and developmental problems receive coordinated care in pediatric orthopaedics with the highest level of surgical and non-surgical treatments.

Paul W. Esposito, M.D.
Dr. Esposito's special interests are in children's extremity deformities, osteogenesis imperfecta, congenital and developmental disorders, cerebral palsy, and musculoskeletal effects of pediatric obesity.

Matthew A. Halanski, M.D.
Dr. Halanski's special interests include the immature bone and growth stimulation, animal modeling, scoliosis, cast application and removal, clinical aspects of clubfoot and its treatment, and care of children with spinal muscular atrophy and other neuromuscular conditions.

Brian P. Hasley, M.D.
Dr. Hasley's areas of focus are pediatric orthopaedic and pediatric spine surgery.

Susan A. Scherl, M.D.
Dr. Scherl's areas of focus are pediatric orthopaedic trauma and fractures.

Maegen J. Wallace, M.D.
Dr. Wallace specializes in the care of pediatric orthopaedic conditions. She focuses on lower extremity conditions, including the foot, knee and hip.

Foot and Ankle Surgery

UNMC's foot and ankle team treats patients with lower extremity conditions, including trauma, hammertoes, bunions, flat feet, great toe arthritis, plantar fasciitis, ankle instability, charcot deformity, ankle arthroplasty and sports injuries.

Alexander B. Swatzke, M.D.
Dr. Sawatzke specializes in a variety of lower extremity conditions, including foot and ankle trauma, deformity and sports injuries.

Hand & Upper Extremity Surgery

Our dedicated hand, upper extremity and microvascular surgeons have specialized training in the treatment of a full range of degenerative, traumatic and sports-related conditions affecting the hand, wrist, forearm, elbow and shoulder. These conditions include carpal and cubital tunnel syndrome, trigger finger, tennis elbow, fractures, arthritis and tendon and nerve injuries.

Patients are treated with alternatives ranging from non-operative modalities to state-of-the-art surgical interventions.

Daniel E. Firestone, M.D.
Dr. Firestone specializes in complex wrist fractures, local/wide awake hand surgery and implant design for hand and wrist surgery.

Joseph A. Morgan, M.D.
Dr. Morgan specializes in the complete care of the upper extremity. His clinical interests include treatment of nerve injuries and compressive neuropathies, microvascular surgery, degenerative conditions and traumatic injuries to the hand and wrist.

Philipp N. Streubel, M.D.
Dr. Streubel specializes in comprehensive care of the upper extremity. His clinical interest focuses on degenerative conditions and traumatic and overuse injuries of the shoulder, elbow, wrist and hand. His research interests include shoulder arthroplasty and the treatment of elbow stiffness and instability, as well as management of thumb arthritis, wrist fractures and trauma of the proximal and distal humerus.

Sports Medicine

The department's sports medicine specialists treat competitive and recreational athletes' injuries or illnesses, with a goal to help them return to their active lifestyles as quickly as possible. Ailments we often see include strains, sprains, or ligament and cartilage injury of the knee, hip, shoulder and ankle joints; instability of these major joints; and running injuries.

Katie L. Freeman, M.D.
Dr. Freeman's areas of focus include knee injuries and conditions such as ACL tears, multiligament knee injuries, patella instability, meniscus tears and cartilage defects. She also specializes in athletic foot and ankle issues, hip arthroscopy, and shoulder injuries and conditions such as rotator cuff tears and shoulder instability.

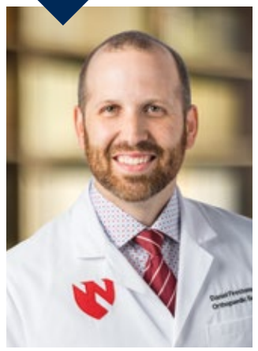
Philipp N. Streubel, M.D.
Dr. Streubel specializes in comprehensive care of the upper extremity. His clinical interest focuses on degenerative conditions and traumatic and overuse injuries of the shoulder, elbow, wrist and hand. His research interests include shoulder arthroplasty and the treatment of elbow stiffness and instability, as well as management of thumb arthritis, wrist fractures and trauma of the proximal and distal humerus.

Matthew A. Tao, M.D.
Dr. Tao specializes in athletic knee issues, including ACL tears, multi-ligament knee injuries, complex cartilage defects, malalignment and meniscal tears. He also specializes in arthroscopic shoulder surgery, including shoulder instability, rotator cuff pathology and biceps disease.

Matthew J. Teusink, M.D.
Dr. Teusink's clinical expertise is in shoulder and elbow replacement, fractures and arthroscopy. His special interests are reverse shoulder replacement, including revision shoulder replacements, as well as arthroscopic management of tendon and ligament tears around the shoulder.

NEW **FACULTY**

Daniel E. Firestone, M.D.



Hand, Wrist & Upper Extremity Surgery

Daniel E. Firestone, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation as an assistant professor in August 2017. He specializes in hand, wrist and upper extremity surgery.

A Lincoln native, Dr. Firestone graduated from Nebraska Wesleyan University with an undergraduate degree in biology. He earned a medical degree from the University of Iowa Carver College of Medicine (2006). Dr. Firestone completed an orthopaedic surgery residency at Creighton University/University of Nebraska Health Foundation (2011) and a hand and upper extremity surgery fellowship at the Indiana Hand to Shoulder Center (2012). He practiced medicine in Nebraska and Kansas before joining the UNMC faculty.

Dr. Firestone specializes in complex wrist fractures, local/wide awake hand surgery and implant design for hand and wrist surgery. He has received a Subspecialty Certificate in Surgery of the Hand by the American Board of Orthopaedic Surgery. The elective certification demonstrates qualifications in hand surgery beyond those expected of other orthopaedic surgeons, including a diverse and high-volume hand surgery practice and passing a standardized exam.

He is a member of the American Board of Orthopaedic Surgeons and a candidate member of the American Society for Surgery of the Hand.

Honors, Awards and Offices Held:
Provisional patent accepted for "Firestone Next Generation Distal Radius System" 2018.

Katie L. Freeman, M.D.

Sports Medicine & Arthroscopic Surgery



Katie L. Freeman, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation as an assistant professor in August 2018. She is fellowship-trained in sports medicine from the Fairview/Minnesota Orthopaedic Sports Medicine Institute.

Dr. Freeman grew up in Urbandale, Iowa, and received her undergraduate degree in chemistry from the University of South Dakota, where she played Division II soccer. She earned her medical degree at the University of Iowa Carver College of Medicine (2012) and completed a general surgery internship at the University of California, San Francisco (2013) and an orthopaedic surgery residency at the University of Missouri (2017).

Dr. Freeman's areas of focus include knee injuries and conditions such as ACL tears, multiligament knee injuries, patella instability, meniscus tears and cartilage defects. She also specializes in athletic foot and ankle issues, hip arthroscopy, and shoulder injuries and conditions such as rotator cuff tears and shoulder instability.

Dr. Freeman is a member of the American Academy of Orthopaedic Surgeons, the American Orthopaedic Society for Sports Medicine and the Arthroscopy Association of North America.

Matthew A. Halanski, M.D.

Pediatric Orthopaedic Surgery



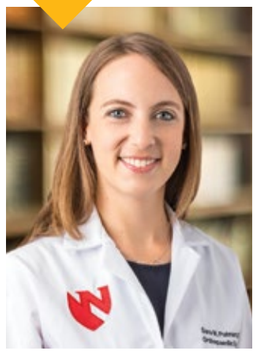
Matthew A. Halanski, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation as an Associate Professor in February. Dr. Halanski is also the division chief of Pediatric Orthopedics and Sports Medicine at Children's Hospital. He brings more than 11 years of experience as a surgeon, the last seven years as a faculty member at the University of Wisconsin School of Medicine and Public Health.

A native of the Detroit area, Dr. Halanski received his medical degree from Wayne State University in Detroit, Michigan (2001). He completed an orthopaedic surgery residency at the University of Wisconsin, Madison (2006) and a pediatric orthopaedic surgery fellowship at Starship Children's Health in Auckland, New Zealand (2007).

Dr. Halanski has become recognized in the orthopaedic community as a leader in pediatric orthopedic research. Dr. Halanski's special interests include: the immature bone and growth stimulation, animal modeling, scoliosis, cast application and removal, clinical aspects of clubfoot and its treatment, and care of children with spinal muscular atrophy and other neuromuscular conditions.

He is board certified by the American Board of Orthopedic Surgery (ABOS). He is a member of the American Academy of Orthopaedic Surgeons, the Pediatric Orthopaedic Society of North America, the Orthopaedic Research Society, the American Academy for Cerebral Palsy and Developmental Medicine, and a candidate member of the Scoliosis Research Society.

Sara M. Putnam, M.D.



Orthopaedic Traumatology

Sara M. Putnam, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation as an assistant professor in August 2018. She specializes in orthopaedic traumatology.

A Kansas native, Dr. Putnam received her undergraduate degree in biological sciences from the University of Notre Dame. She earned a medical degree from Washington University in St. Louis (2012). Dr. Putnam completed an orthopaedic residency at Washington University/Barnes-Jewish Hospital (2017) and an orthopaedic traumatology fellowship at Harborview Medical Center-University of Washington in Seattle (2018).

Dr. Putnam specializes in orthopaedic fracture care, care of the polytraumatized patient, fractures near or involving joints (periarticular fractures), fractures of the pelvis and acetabulum, nonunions, and malunions. Additional research interests include studying how social support and access to care affect patient outcomes following trauma.

She is a member of the American Academy of Orthopaedic Surgeons, the Orthopaedic Trauma Association and the Mid-America Orthopaedic Association.

Refereed Articles:

Cosgrove, C., Spraggs-Hughes, A., Putnam, S., Ricci, W., Miller, A., McAndrew, C., Gardner, M. A novel indirect reduction technique in ankle syndesmotic injuries: A cadaveric study. Journal of Orthopaedic Trauma. 2018; 32(7):361-7.

Cosgrove ,C., Putnam, S., Cherney, S., Ricci, W., Spraggs-Hughes, A., McAndrew, C., Gardner, M. Medial clamp tine positioning affects ankle syndesmosis malreduction. Journal of Orthopaedic Trauma. 2017; 31(8):440-6.

Putnam, S., Linn, M., Spraggs-Hughes, A., McAndrew, C., Ricci, W., Gardner, M. Simulating clamp placement across the trans-syndesmotic angle of the ankle to minimize malreduction: A radiological study. Injury. 2017; 48(3):770-5.

Alexander B. Sawatzke, M.D

Foot & Ankle Surgery



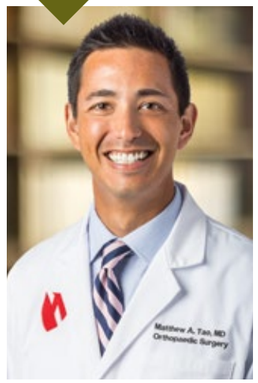
Alexander B. Sawatzke, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation as an assistant professor in August 2019. He is fellowship-trained in foot and ankle surgery.

A native of Council Bluffs, Iowa, Dr. Sawatzke received his undergraduate degree in integrative physiology from the University of Iowa (2009) and his medical degree from the University of Iowa Carver College of Medicine (2013). He completed an orthopaedic surgery residency at Grand Rapids Medical Education Partners (2018) and an orthopaedic surgery foot and ankle fellowship at the University of Washington School of Medicine (2019).

Dr. Sawatzke's areas of focus include: foot and ankle trauma, hammertoes, bunions, flat feet, great toe arthritis, plantar fasciitis, sports injury of the foot and ankle, ankle instability, arthritis of the foot and ankle including ankle arthroplasty, foot and ankle deformity, Charcot deformity, and lower extremity deformity.

Dr. Sawatzke is a member of the American Orthopaedic Foot and Ankle Society, American Academy of Orthopaedic Surgeons, American Medical Association, Alpha Omega Alpha National Medical Honor Society and The American Orthopaedic Association.

Matthew A. Tao, M.D.



Sports Medicine & Arthroscopic Surgery

Matthew A. Tao, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation as an assistant professor in August 2017. He specializes in sports medicine and arthroscopic surgery.

Dr. Tao grew up in Lafayette, Indiana, and graduated from Calvin College in Grand Rapids, Michigan, with a major in biochemistry. After earning his medical degree from Northwestern University (2011), he completed an orthopaedic surgery residency at Duke University (2016) and a sports medicine & shoulder surgery fellowship at Hospital for Special Surgery in New York (2017).

During his residency and fellowship training, Dr. Tao helped provide team coverage for the New York Giants, New York Red Bulls and multiple Duke University teams, including football, volleyball and men's and women's basketball.

Dr. Tao specializes in athletic knee issues, including ACL tears, multi-ligament knee injuries, complex cartilage defects, malalignment and meniscal tears. He also specializes in arthroscopic shoulder surgery, including shoulder instability, rotator cuff pathology and biceps disease.

He is a member of the American Academy of Orthopaedic Surgeons, the American Orthopaedic Society for Sports Medicine and the Piedmont Orthopaedic Society.

Current Research Grants:

Nebraska Banker's Association. Awarded $8,319 in conjunction with Dr. Elizabeth Wellsandt toward the pursuit of gait-based research at University of Nebraska Medical Center. April 2018.

UNMC College of Medicine. Awarded $5,085 toward the pursuit of evaluating sleep as a predictor of academic performance in medical students. July 2018.

Refereed Articles:

Fader, R,, Tao, M., Gaudiani, M., Turk, R., Nwachukwu, B., Esposito, C., Ranawat, A. The Role of Lumbar Lordosis and Pelvic Sagittal Balance in Femoroacetabular Impingement. Bone & Joint J 2018;100-B:1275-1279.

Rauck, C., Wang, D., Tao, M. Williams, R: (2018). Chondral Delamination of Fresh Osteochondral Allografts after Implantation in the Knee: A Matched Cohort Analysis. Cartilage. 1947603518777576.

Tao, M., Calcei, J., Taylor, S. Biceps Tenodesis: Anatomic Tensioning. Arthroscop Techn 2017;6:e1125-1129.

Tao, M. Better Education Through Sports: An Ode to the Rock. Duke Orthop J 2017;7:XIV-XV.

Tao, M., Karas, V., Laver, L., Riboh, J., Garrigues, G. Management of the Stiff Shoulder with Arthroscopic Circumferential Capsulotomy and Axillary Nerve Release. Arthroscop Techn 2017;6:e1-6.

Book Chapter and Reviews:

Tao, M. Altchek, D. (2018). DeLee & Drez's Orthopaedic Sports Medicine: Principles & Practice. Saunders; 2018. The Thrower's Shoulder

Tao, M., Wang, D., Williams, R. (2018). Return to Play in Football [Soccer]: An Evidence Based Approach. Springer-Verlag; Ethical Issues: Surgical Implications for Return to Play

Taylor, S., Calcei, J., Tao, M. (2018). Shoulder Surgery: Tricks of the Trade. Thieme; Internal Impingement

Tao, M., Wang, D., Williams, R. (2018). Return to Play in Football: An Evidence Based Approach. 1. Springer, Berlin, Heidelberg; Chapter 62, Ethical Issues in Return to Play: Surgical Implications for Return to Play; 825-832

Honors, Awards and Offices Held:

Nebraska Medicine:

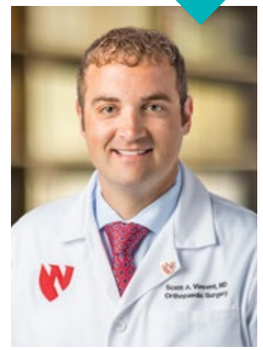
- Member, Sports Medicine Steering Committee, 2017-present
- Member, Orthopaedics Operations Committee, 2017-present

Best Scientific Paper 2017. The Role of Lumbar Lordosis and Pelvic Sagittal Balance in Femoroacetabular Impingement. International Society for Hip Arthroscopy Annual Meeting (Santiago, Chile). October 12-14, 2017.

Warren R. Kadrmas Award 2017. Presented by the Hospital of Special Surgery Sports Medicine & Shoulder Service to the fellow "who has demonstrated the highest level of citizenship and dedication to sports medicine."

Editorial Board, Current Reviews in Musculoskeletal Medicine

Scott A. Vincent, M.D.



Adult Spine Surgery

Scott A. Vincent joined the Department of Orthopaedic Surgery and Rehabilitation as an assistant professor in August 2017. He completed a spine surgery fellowship at the University of Wisconsin School of Medicine and Public Health in 2017 and specializes in adult spine surgery.

A native of York, Nebraska, Dr. Vincent graduated from the University of Nebraska at Kearney with a bachelor's degree in chemistry. He attended the University of Nebraska Medical Center for medical school (2011) and residency (2016). While a resident at UNMC, Dr. Vincent received the Award for Outstanding Junior Resident (2013) and the Frank P. Stone, M.D. Award for Academic Excellence (2016).

Dr. Vincent's expertise includes spine trauma, spinal cord injury, tumors of the spinal column and degenerative conditions of the cervical, thoracic and lumbar spine. His special interests also include less invasive surgical treatment options for spinal pathology.

He is a member of the American Academy of Orthopaedic Surgeons, the Lumbar Spine Research Society, the Alpha Omega Alpha Honor Medical Society and an American Orthopaedic Association Emerging Leader.

Refereed Articles:

Vincent, S., Anderson, P. The Unstable Spine: A Surgeon's Perspective. Seminars in Ultrasound, CT, and MRI. Elsevier; 2018.

Book Chapter and Reviews:

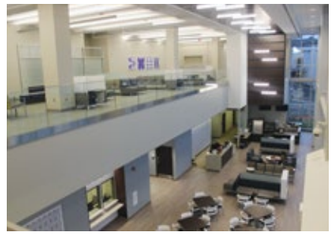
Vincent, S., Gannon, E., Moore, D. Handbook of Spine Technology. Springer; 2018.
Kyphoplasty Techniques

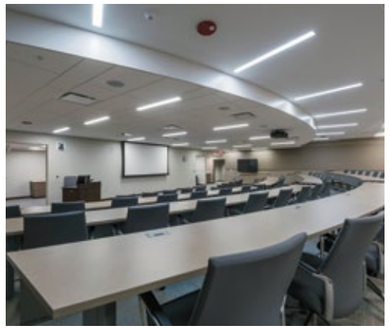
Honors, Awards and Offices Held:

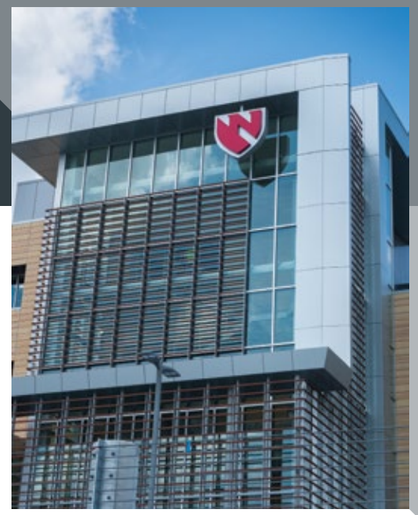
Course Director, Department of Orthopaedic Surgery Grand Rounds, UNMC, 2018-Present

Lumbar Spine Research Society, Membership Committee

FOUNDATION FOR **COLLABORATION**







> This move marked the first time that our clinic, academic offices and research labs have been housed in one location. It has created the optimal environment for us to truly live up to our tripartite mission of patient care, education and research.
> – Kevin Garvin, M.D.

In fall 2016, the Department of Orthopaedic Surgery moved under one roof. The newly completed $70.8 million Lauritzen Outpatient Center and Fritch Surgery Center has nearly 170,000 square feet of surgical, research and educational space.

In addition to new office and work space for department faculty, residents, academic support and research staff, the orthopaedic area includes the Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory, multiple conference rooms, an auditorium able to accommodate more than 75 people and dedicated space for resident education and research. The fourth floor also includes a new center for Telehealth services.

"This move marked the first time in many years that our clinic, academic offices and research labs have been housed in one location," Dr. Garvin said. "It has created the optimal environment for us to truly live up to our tripartite mission of patient care, education and research."

The Orthopaedic clinic space is equipped with 28 state-of-the-art exam rooms shared with Physical and Occupational Therapy services. Each room provides easy access to Radiology and Pharmacy services. The building also has 10 outpatient operating rooms, a central check-in location and an underground parking garage for patients.

This type of outpatient environment promotes constant collaboration among physicians, facilities, management and staff to develop new ways, space and processes to deliver care. The building provides an ideal setting for patients to access the many services previously spread throughout our sprawling campus.

CORE

At the University of Nebraska Medical Center Department of Orthopaedic Surgery and Rehabilitation, **EXCELLENCE** and **PROFESSIONALISM** are the core of what we do. For us, there is no ordinary or routine case. We strive for exceptional results for each and every patient.

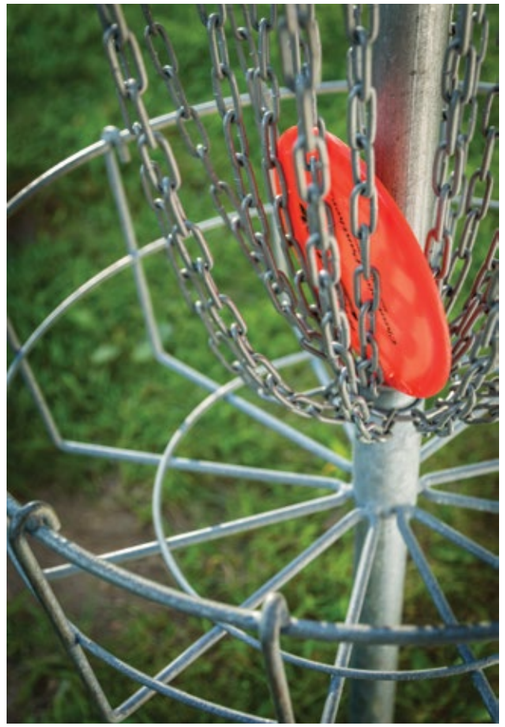
Because using the highest standards of safety and quality to get our patients back to doing the things they love is what we do. Every day.

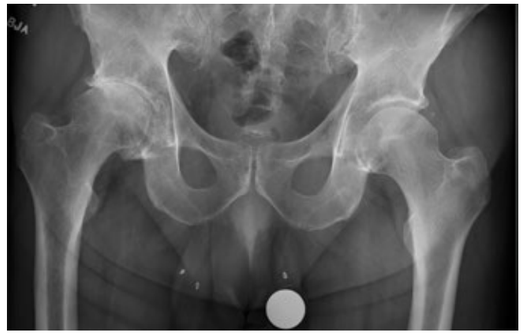
I grew up around junk and had to learn all the body work skills, including welding and assembling and riveting. I would rebuild or make things because of the way the culture was–to rebuild. –Mark Goodall

REBUILDING A LIFE











Top: Mark's right hip before total hip replacement. Bottom: Mark's right hip after total hip replacement.



There is one thing that Omaha resident Mark Goodall has always enjoyed – an active lifestyle. He's an attorney of more than four decades, a former Chinese linguist airman in the Vietnam War, a disc golf champion, a world traveler, and an artist who makes incredible creations out of reclaimed trash.

Back in fall of 2015, an incident started Mark on a path that threatened his active lifestyle.

The autumn sun had set and north Omaha's Hummel Park disc golf course was rapidly losing light. Mark planned to quickly finish his disc golf game before dark. As he walked down a fairway, he spotted a stick in his path and kicked it out of the way.

However, the stick turned out to be tree root, firmly attached to the ground. His foot lodged under the root as he fell to the ground on the fairway.

"I did an ugly twisting fall," Mark said. "At different times in my life I've been complimented on my nice rolling falls, but I couldn't do that with one foot hooked."

Although the fall didn't immediately land Mark in the hospital, the plaguing knee and hip issues eventually led him to visit a sports medicine doctor, who particularly tuned in to the hip pain.

Mark hoped his pain was from the soft tissue surrounding his hip joint and would improve with time and physical therapy.

However, Mark's pain didn't improve – it got worse.

Pain in his right hip began limiting his ability to participate in competitive disc golf, a sport he became involved in at age 61, when he answered the call to build a course at Hummel Park in 2010. At the time, he mixed concrete and dug tee pads in the park, working alongside others who had a passion for the game. He quickly caught their enthusiasm for the sport he now calls the perfect exercise – walking between eighteen holes, navigating a course with hills and obstacles, and using a variety of body movements for disc throwing.

Just five years after first throwing a disc, Mark brought home a trophy from the PDGA Coca-Cola Classic in Atlantic, Iowa. He placed second, in his division, competing against athletes who had been involved in the sport for 20-35 years.

But the plaguing pain that began on that autumn evening in 2015 – shortly after his success at the tournament – was now threatening his active lifestyle. As the pain worsened over a 18-24-month period, he began walking with a cane, which restricted his everyday activities.

While on a trip to Paris in October 2017, it became apparent to Mark that he needed to consult with an orthopaedic surgeon about his hip pain and increasingly limited mobility. Upon returning stateside, he met with adult reconstruction surgeon Beau Konigsberg at UNMC. X-rays revealed severe arthritis in his right hip. Dr. Konigsberg believed a total hip replacement was the only path to reduce Mark's hip pain and restore his mobility.

"Mark had a significantly stiff hip with a flexion contracture and extremely limited internal and external rotation," Dr. Konigsberg said.

Mark successfully underwent hip replacement surgery the following month. The Rapid Recovery program at UNMC supports patients in returning to activities quickly by using a specialized anesthetic block and providing preoperative orthopaedics education. Mark was able to walk the day of the surgery and left the hospital the following day.

"The whole experience was a lot of fun," Mark said. "I was treated very well and everyone was very pleasant."

Mark quickly progressed from a walker to a cane, and then walking without a cane or pain. He found that writing a daily log of his recovery, such as wound condition, medications and physical activities, helped him to focus on his rehabilitation.

The sport that first slowed Mark's active lifestyle also helped him recover and get back to the things he loves to do. Too soon to play on the hilly Hummel Park disc golf course, he brought the course to his house by throwing discs at baskets he set up on the lawn of his north Omaha home.

Once Mark was ready to fully get back to disc golf, he also took up another activity he enjoys – mentoring people in the community who are interested in beginning the game. A native of Minnesota, Mark has been a fixture of the Omaha community for decades. He was stationed at Offutt Air Force Base after a tour as a Chinese linguist airman in the Vietnam War, and later attended University of Nebraska at Omaha. After law school in California, he returned to Omaha and started on what he calls the "yuppie path to partner in a large firm," before later founding his own firm in 1995 that specialized in start-up businesses, divorce and estate planning.



Something else Mark is glad to be able to do pain free is his art – which he calls found object assemblage sculpture. The art form requires scouting flea markets and second-hand stores to find old objects, ranging from antique vacuum cleaners to vintage toasters to Barbie dolls. He then imagines an ingenious use for each and brings his vision to life by combining elements of multiple objects. A series of vintage toasters might be connected as train cars, a vacuum cleaner might become a roadster with a doll at the wheel, or a bike could get a second life as a rocket.

Mark's interest in this kind of art stems from his childhood – the son of parents who operated a body shop and salvage yard. While on tour as an airman in Vietnam, he took the kinds of skills he learned as a child to create art out of used C-ration cans.

"I grew up around junk and had to learn all the body work skills including welding and assembling and riveting," he said. "I would rebuild or make things because of the way the culture was – to rebuild."

> "Mark was eager to get back to full activities and progressed quicker than most patients due to his positive outlook and enthusiasm."
> – Beau S. Konigsberg, M.D.

Today, he also shares his passion for art with a younger generation. He volunteers as a collaborating artist with Girls Scouts of Nebraska in the winter months and helps girls prepare found object art projects for an annual spring art gala.

Mark is now back to his old self and happy to lead the active lifestyle he enjoys.

"Mark was eager to get back to full activities and progressed quicker than most patients due to his positive outlook and enthusiasm," Dr. Konigsberg said. "He kept me updated regularly with his progress and it was a pleasure to get him back to the activities he enjoys and see the joy it brings him." ■

CORE

At the University of Nebraska Medical Center Department of Orthopaedic Surgery and Rehabilitation, we believe in **LEADERSHIP** through example, education and experience. We believe that innovation can change the way we heal. And we believe advances in orthopaedic medicine – found through **LIFELONG LEARNING** – exist for the needs of our patients.

This is our core.



> I felt good going into the surgery because it was going to be on time for college. Walking through campus was going to be a big issue for me with how my knee was before the surgery. – Kristopher Kodat

NOTHING BUT NET





When Kristopher Kodat crossed the stage to graduate from Bellevue West High School in May 2018, he did so with one crutch, a brace and a new lease on life – one month after being the first meniscus transplant patient at UNMC.

Increasingly severe knee pain had transformed Kris from an active teen who loved playing basketball to a high school student struggling with normal day-to-day activities. Constant pain plagued the lateral side of his knee. Despite loving basketball, playing any sport was out of the question, and even the typical daily schedule of classes and extra-curricular activities led to regular catching, locking and swelling in his knee.

The first time Kris experienced anything unusual with his knee was after a soccer injury in 6th grade. He was told he had tendonitis and also learned that he had a "discoid" meniscus instead of the more normal c-shape.

The menisci serve as shock absorbers in the knee and help the joint move well. Having a discoid meniscus meant that Kris had more meniscal tissue than normal. This extra tissue is abnormal in nature and can often cause issues, including unpredictable healing. In Kris' case, he began having more frequent trouble with running and sports. During these activities, the knee would frequently cause pain and mechanical sensations.

As a high school sophomore, Kris began experiencing more regular and severe pain. At one point, while visiting his brother in Idaho, he found that he could not walk on his right leg. An emergency room visit left him with the possible diagnosis of a torn meniscus. Upon returning to Omaha, an MRI revealed that Kris' meniscus had actually flipped on itself.

Kris had his first surgery to repair the tear in October 2016. Unfortunately, he suffered another injury after that and was diagnosed with a repeat meniscal tear. He had a revision repair in May 2017 but ultimately did not progress well following the second surgery. Issues like this can be all too common in the setting of discoid menisci, as the tissue itself is abnormal and unpredictable.

As Kris continued to experience issues over the summer, his doctor referred him to Matthew Tao, M.D., a sports medicine surgeon at UNMC who specializes in knee and shoulder issues.

At the time Dr. Tao met him, Kris was functionally meniscal deficient, meaning that his residual meniscus tissue was no longer performing normally. Dr. Tao told Kris and his parents that a meniscus transplant was the best way to give Kris a chance at leading an active life in the future.

"I spent quite a while talking to Kris and his folks ahead of time about this," Dr. Tao said. "I truly felt this was one of the only options that could potentially decrease his pain, improve his function and get him back to a relatively normal life."

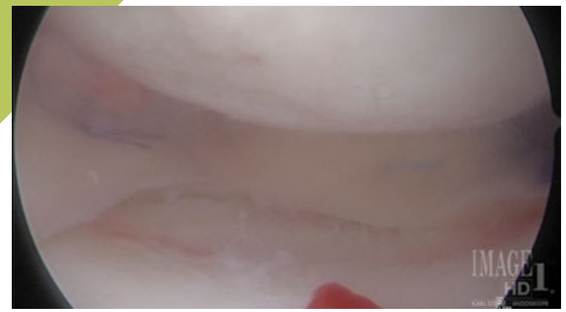
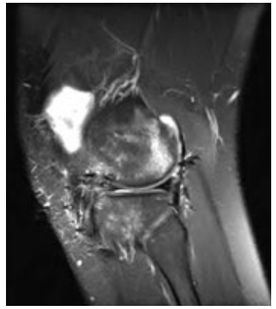
Beginning in October 2017, Kris was on call for a meniscus transplant at UNMC. In April 2018, he and his family got the call that a graft was available, and Dr. Tao performed a lateral meniscus transplant shortly thereafter. As with other transplants, meniscal grafts are cadaveric tissue that come from organ donors and are meticulously sized to match a given patient's knee. During surgery, the graft is secured down to the bone on each end, and the tissue is sutured to the lining of the knee capsule.

"Transplants like this truly are a special gift, and certainly, organ transplants have the potential to be life-saving. But one thing I love about orthopaedics, and sports medicine in particular, is that some of our operations have the potential to be life-changing in terms of pain, function and overall quality of life," Dr. Tao said.

During rehab, Kris slowly increased his motion and began putting more weight on his affected knee over time. The tissue is slow to integrate into the body, so rehabilitation needs to gradually and progressively build up motion and strength. After a relatively quiet first few months, Kris advanced to more strenuous exercises under the guidance of an experienced physical therapist in what was ultimately a yearlong process.

The determination to work hard and keep the mind focused on a positive outcome – a hallmark of many great athletes – has served Kris well in his recovery and aligns with the perspective of the entire Sports Medicine program at UNMC.



Top left: Arthroscopic photos of Kris' knee before transplant. Lower left: Arthroscopic photos of Kris' knee after transplant. Top and lower right: Coronal and Sagittal photos taken 6 months after surgery demonstrating the intact meniscus, particularly emphasizing the relatively normal appearance of the posterior horn.

> Transplants like this truly are a special gift, and certainly, organ transplants have the potential to be life-saving. But one thing I love about orthopaedics, and sports medicine in particular, is that some of our operations have the potential to be life-changing in terms of pain, function and overall quality of life. – Matthew A. Tao, M.D.

"One of the things I love about this place is that we embrace the idea that recovery is a team sport," Dr. Tao said. "Kris is at the center of the huddle, but we try to assemble a great group of people around him. He has worked incredibly hard in and out of therapy to get his strength back and regain a functional knee. I'm very pleased with his progress and the fact that he is essentially asymptomatic at this point."

Today, Kris is able to navigate the University of Nebraska at Omaha campus without pain, a limp or locking in his knee. He is studying criminal justice and hopes to become a law enforcement officer after college and eventually work as a detective. And he even plans to join an intramural basketball team eventually at UNO.

"I felt good going into the surgery because it was going to be on time for college," Kris said. "Walking through campus was going to be a big issue for me with how my knee was before the surgery."

Prior his meniscus transplant, the series of injuries, surgeries and persistent issues had left Kris feeling like he was out of options and doubting if he would ever have a functioning knee again. And while Dr. Tao says Kris will need a revision transplant at some point in the future, Kris' new meniscus is allowing him to be an active young adult.

"Even early on, this meniscal transplant has dramatically changed Kris' day-to-day life," Dr. Tao said. "I certainly hope that continues and lasts as long as possible so he can stay active and doing the things he loves."

CORE

At the University of Nebraska Medical Center Department of Orthopaedic Surgery and Rehabilitation, we know that it takes **COURAGE** to make tough decisions. That a fear of failure has no place in the pursuit of excellence. And that **HEALING** is a process of both empathy and care.

Because at its core, our work is about walking with our patients to a better future.

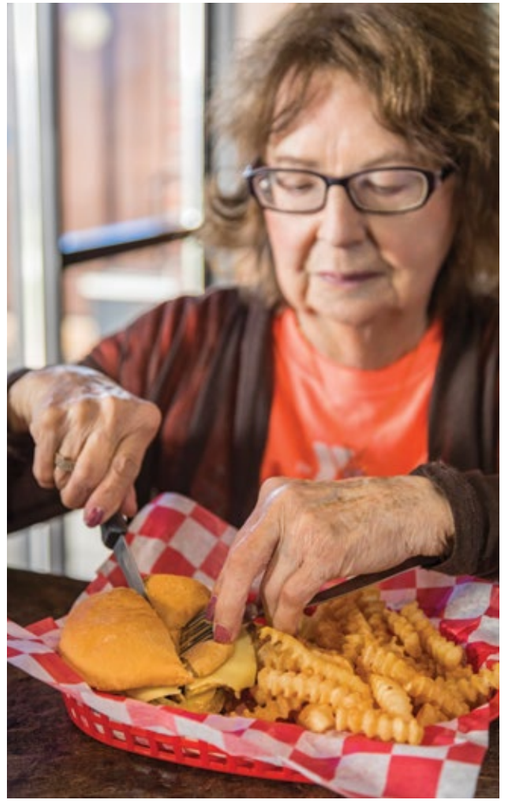
> I wouldn't look at myself for months. I had cuts and bites all over my face, two black eyes and my arms all bandaged. – Sharon Robino

REBUILDING A LIFE











Upbeat music plays over the speaker system and the morning class at the Valley, Nebraska, YMCA begins. Sharon Robino places a resistance band under her right foot, grasps the two ends with her hands and pulls the band from her waist to her head. Next, she grips a dumbbell in each hand and moves her arms in front of her, to the side and then back down. She sits down and does the weight routine again, this time easily lifting her leg at the same time to challenge her strength.

This morning, Sharon cooked her own breakfast, drove to the YMCA and is now lifting weights – all things that once seemed impossible for her. In 2016, she suffered a brutal attack that left her in critical condition and uncertain if she would ever regain use of her hands and arms.

On an October evening in 2016, Sharon was settling in to watch the U.S. presidential debate at her farmhouse outside Valley, Nebraska, when she tripped over a box. Her 3-year old English shepherd quickly came to her side, but to Sharon's surprise, he began attacking her while she was still on the floor.

"I was shocked that he would do that because we would do everything together," Sharon said of the dog who had been by her side since he was a puppy.

Sharon tried speaking to the dog in a firm tone and then a gentle one, but the attack only grew more gruesome. As she tried to hit him away, he grabbed and tore at her arms over the winter jacket she was wearing. When she eventually was able to get up on her knees, the dog began biting her head and face.

"He was out to kill and I thought I was going to die," she said. "I could feel life going out of my body."

Sharon's husband, Pat, who had been upstairs, came to her side. For whatever reason, all it took was a "leave, Prince" from Pat and the dog completely ceased the attack. However, the attack left Sharon in critical condition with a significant amount of blood loss.

Because Sharon had been wearing a winter jacket that covered her arms, it initially appeared that she had predominantly suffered injuries to her face and head. However, once first responders arrived at the scene and removed Sharon's jacket, the seriousness of her hand and arm injuries quickly became evident.

> I think this team approach really benefited her, as she was able to heal her flap beautifully, and her fractures healed as well. – Joseph A. Morgan. M.D.

The Valley and Waterloo rescue squad rushed Sharon to UNMC, where Dr. Joseph Morgan, a hand and upper extremity surgeon, was on duty. Along with injuries to her face and scalp, Sharon had severe dog bite injuries to both of her forearms. She had fractures in both the radius and ulna in both forearms as well as the left fifth metacarpal. Both forearms also sustained severe soft tissue injuries.

"Sharon's injuries were quite severe, with both bones in each forearm broken and little soft tissue keeping her hands connected to her arms," Dr. Morgan said. "Early on, I definitely had concerns that she might lose her hands as a result of this injury."

Sharon was taken to the operating room the night of her injury for fixation of her fractures and cleaning of her wounds, although multiple subsequent operations were necessary to help her recover from the devastating injury.

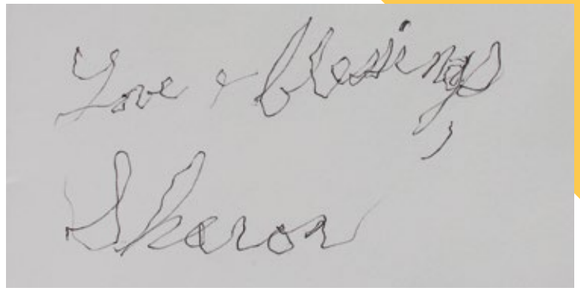
"I wouldn't look at myself for months," she said. "I had cuts and bits all over my face, two black eyes and my arms all bandaged."

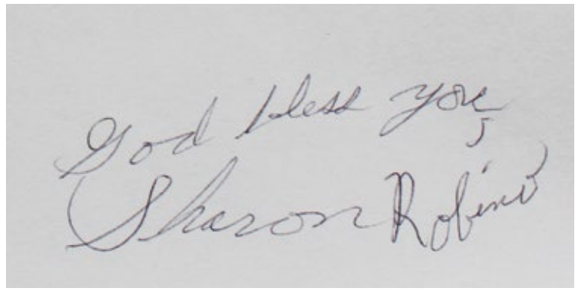
Unfortunately, Sharon's right forearm did not initially heal well and there was a large soft tissue defect that was complicated by a fungal infection. This required multiple debridements to remove the affected tissue, as well as flap coverage. Because of the complexity of the case, Dr. Morgan requested that Dr. Shannon Wong, a plastic surgeon at UNMC, assist in covering her defect.

At the same time that Dr. Morgan placed a bone graft from Sharon's hip to her fractures, Dr. Wong did a gracilis flap, in which a muscle from Sharon's leg was harvested with an artery and sewn into one of the arteries in her forearm. Early in Sharon's treatment, much attention was paid to making sure the artery stayed open and not clotted off, allowing the flap to stay alive and Sharon to keep her arm.









Left images: Sharon's right wrist following the attack (left) and Sharon's wrist after surgery (right). Right images: The signature from Sharon's Christmas card to Dr. Morgan, just two months after her attack (top), and the signature from her Easter card to Dr. Morgan just months later (bottom).

"I think this team approach really benefited her, as she was able to heal her flap beautifully, and her fractures healed as well," Dr. Morgan said.

Sharon remembers the long and difficult recovery process following the attack, but she also remembers the people who stepped in to offer their support and encouragement.

She remembers her church family at Community of Grace in Elkhorn, who flooded UNMC with more than 300 visitors and sang carols over the holidays while she was healing from her injuries. She remembers her husband Pat, who died of cancer a year after her injuries. Pat not only ended the attack and supported her through surgeries and rehabilitation, but also left her with the confidence that she would be able to drive again. She remembers her four children, who spent time with her at the hospital. And she remembers Dr. Morgan, whose skill as a surgeon has restored her ability to do the things she loves.

"Dr. Morgan did a wonderful job patching it up," she said. "Thank goodness for him."

In the six months following the injury, Sharon went back and forth between the Douglas County Rehabilitation Center in Omaha and UNMC for a series of surgeries. Afterwards, she spent time at Nye Health Services in Fremont for therapy. About a year after the attack, Sharon was able to return to her Valley home and continue therapy at Nye several times each week.

Because one of her surgeries used a bone graft from her leg, Sharon was afraid her mobility would be affected. However, after therapy on her leg, today she enjoys an active lifestyle – and the ability to do all the things she enjoys. She drives her car, attends a 55 and older exercise class at the YMCA nearly every weekday, comfortably walks up and down stairs and even runs.

At home, Sharon can once again do the tasks that are often taken for granted – opening cans, cutting steak and washing her hair.

What has been particularly remarkable about Sharon's recovery is the incredible progress she has made in her penmanship. Just two months after the injury that fractured both her forearms and left large portions of her soft tissue exposed, she sent Dr. Morgan a Christmas card and signed her name at the bottom.

"It really touched me when, even during one of her hospitalizations, she gave me a Christmas card and told me that it was the first time since her injury that she had written her name," Dr. Morgan said.

Several months later, while in rehabilitation, Sharon surprised Dr. Morgan with an Easter card that showed an astonishing improvement in her handwriting. Since then, her holiday messages to Dr. Morgan have grown longer as she has regained the abilities she had before the injury.

"Sharon still sends me cards at the holidays, and it has been such a blessing to see her handwriting improve season to season. She will always be a very special patient to me," Dr. Morgan said.

CORE

ORTHOPAEDIC
RESEARCH

At the University of Nebraska Medical Center Department of Orthopaedic Surgery and Rehabilitation, we're using cutting-edge research to define tomorrow's methods. Our world-class research program focuses on the areas of musculoskeletal diseases, molecular biology and genetics, development of less invasive surgical techniques and biomedical engineering.

Improving patient care through innovative research is our core.

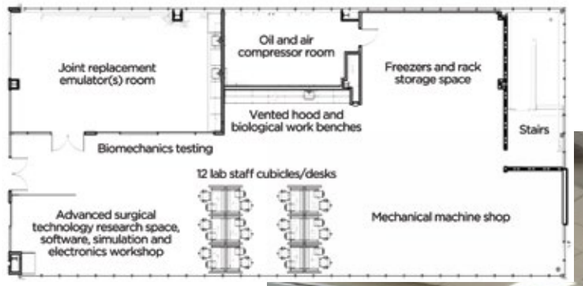
RESEARCH

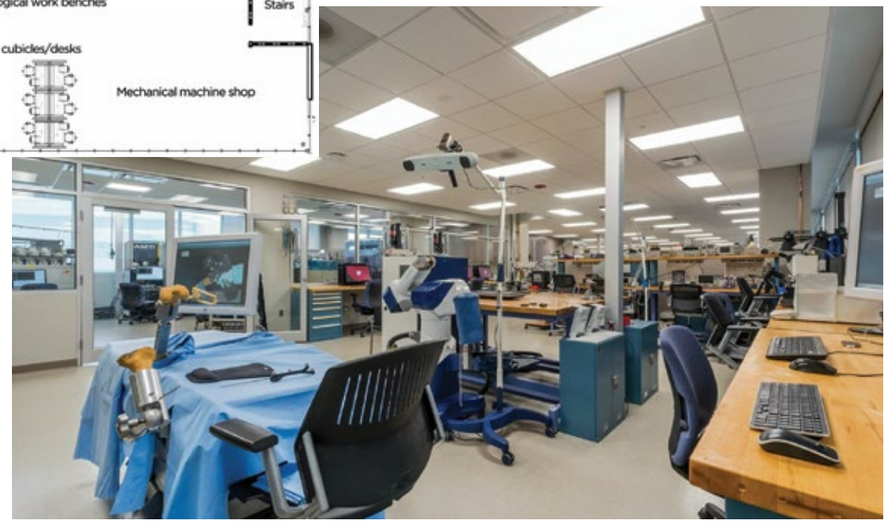
HORIZONS, AND OUR RESEARCH LAB

One year for a three-mile move in Omaha...

Since completion of the Lauritzen Outpatient and Fritch Surgery Center in late 2016, the Biomechanics and Advanced Surgical Technologies Laboratory has moved from its previous location in the Scott Technology Transfer and Incubator Center to its current 4,400 square foot location adjoining the Department of Orthopaedic Surgery.

For years, the lab has advanced into one of the world's largest academic, non-profit, industry-neutral facilities for orthopaedic implant testing, and has fostered innovative surgical technology. As close neighbors now, Dr. Hani Haider, Professor of Orthopaedic Surgery and Lab Director, and his team have been able to strengthen the collaboration between the lab and the orthopaedic department faculty.







View through glass windows of the lab space from the outside corridor



State-of-the art knee, hip and joint simulator room. Contains four separate force-control knee simulators with full computer control and data logging (each simulator has four separate test stations), two AMTI hip wear simulators with 12 test stations and eight separate soak control stations on each. The room also houses four separate stations of the AMTI Vivo generalized joint test machine with virtual soft tissue simulation and 3D axis transformation capability on each. Finally, there is an AMTI Orthopod six-station pin-on-disk testing machine, an in-house built 8-station fatigue machine and a variety of proprietary friction and other testing equipment.

RESEARCH: HORIZONS, AND OUR RESEARCH LAB





Top left: Five hydraulic pumps/compressors in the lab's power room. Each is 3 phase electrically-powered and water cooled from the building chiller. Bottom left: Eight pneumatic compressors (one 4-plex, and two duplexes) to power the knee simulators and other lab equipment, with the air dryer, and cumulating tank.



Above: Bundles of cables at the back of the large MTS 4-axis testing machine.

Naturally, the move to the Lauritzen Outpatient Center fourth floor presented many challenges beginning with preparing the infrastructure in the new lab. For example, the knee and hip testing simulators are not only electrically powered but also pneumatically and hydraulically to provide the large time-varying (dynamic) forces. The lab team had to plan for moving and re-installing eight high-pressure air compressors for the knee simulators, and five separate high power hydraulic oil pumps, some needing 3-phase electrical supply. Some also need liquid cooling from the University's central HVAC system. Other considerations included vibration and noise isolation, the routing of high pressure air lines and hydraulic pressure hoses, and low-pressure oil return through gravity feed to a separate plant room within the lab.

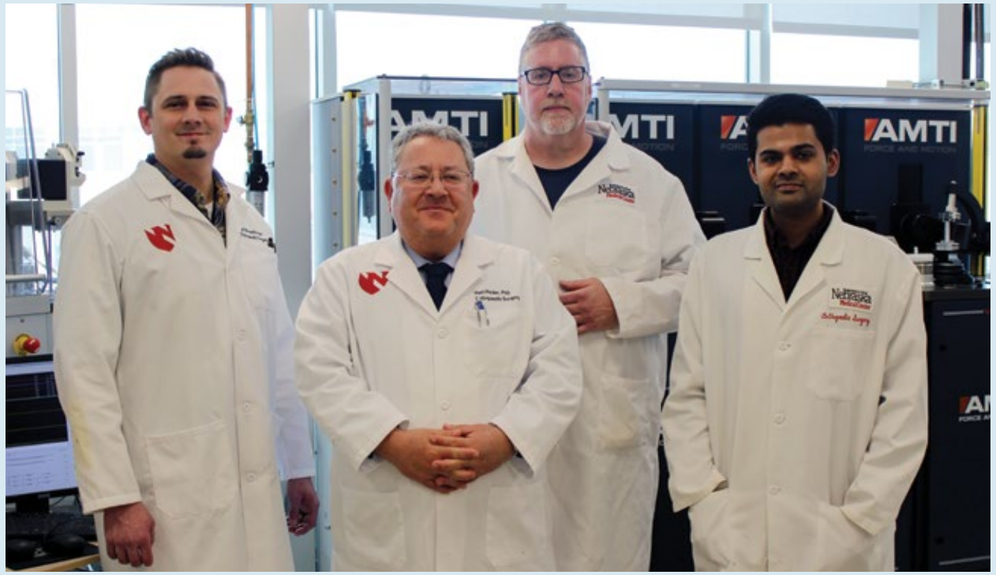
Thanks to their extensive knowledge of this highly specialized equipment, Dr. Haider and his technicians were able to save significant costs by designing and providing the building architects with a computer-aided design plan for the pneumatics and hydraulics themselves instead of hiring outside contractors.

It took the team nearly five months to prepare for the three-mile move to the lab's new location and another seven months to unpack and reassemble. For example, the lab's 4-axis MTS machine, which had been augmented multiple times over the years, had more than 50 cables connecting its actuators, force and motions sensors and other measuring instruments to the machine's control and driver electronics and to the computers with which it interfaces. There was a lot of labelling and intricate work disconnecting, packaging and re-connecting on tens of other test machines, all done by the lab personnel to save costs.

Dr. Haider said that after "much disruption, some chaos, lots of pain, and some laughter, we are excited to be physically in the same place now and to have more opportunities for collaborative research and innovations with our surgeons."

WHY ALL THIS **EQUIPMENT?**

Since the last departmental report in 2016, the lab has worked on 14 separate implant-testing contracts from eight different companies. These projects included hip, knee and other testing of new implant designs and materials. Many were for the U.S. FDA and foreign regulatory clearance purposes. "These are R&D orthopaedic implant projects for real tangible benefits, and not pie-in-the-sky pure academic research endeavors," said Dr. Haider. Overall, on a non-profit basis, the lab has successfully completed more than 90 orthopaedic implant-testing contracts for 32 different orthopaedic companies and university labs in the U.S. and abroad.



(Left to right) Joel Weisenburger, Dr. Hani Haider, David Lusk and Arvind Natarajan

RESEARCH: HORIZONS, AND OUR RESEARCH LAB

The test methods and data that have come out of this lab have earned it a national and international reputation for excellence. In 2017, Dr. Haider received the "Award of Merit" and the honorary title of "Fellow" of ASTM International, the ASTM's highest award "For outstanding leadership and high productivity in fostering the development and promulgation of surgical implant standards."







In 2018, Dr. Haider was elected as the Chair of United States Technical Advisory Group (TAG) and Head of the U.S. Delegation for the International Standards Organization (ISO) Technical Committee on "Implants for Surgery", and also Chair of ASTM International Division II Committee on "Orthopaedic Devices".



In 2018, Dr. Haider received the AAOS Best Poster Prize in the Adult Knee Category out of 7,000 papers submitted.

In that same year the lab won the Biomechanics Award of the International Society for Technology in Arthroplasty for the best full biomechanics paper.





Dr. Hani Haider and the United States delegation in Sydney, Australia at the annual ISO meeting on Implants for surgery.

RESEARCH: HORIZONS, AND OUR RESEARCH LAB

...Setting the Bar...





In December 2017, ten implant reviewers from the FDA's Center for Devices and Radiological Health (CDRH) visited the lab for two days to learn about implant testing techniques.

These reviewers of hip, knee, shoulder, ankle and spinal devices attended six one-hour lectures given by Dr. Haider. They also viewed practical lab demonstrations on cutting-edge implant wear testing and participated in a round table discussion that included arthroplasty and spine surgeons from the Department of Orthopaedic Surgery.



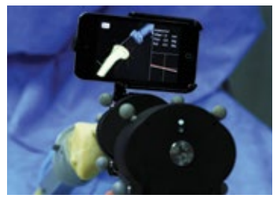
The synergy opened up one matter which does not get enough air time in scientific conferences: how implant failures requiring revision surgery are supposed to be reported into the FDA's Medical Device Adverse Events (MAUDE) online database. The group speculated whether this unenforced process by definition skews or underestimates the reported failures.

John Goode, a senior reviewer with the FDA group and chairman of the International Organization for Standardization, described the UNMC lab as "top of the bar." He said to a press reporter who interviewed him, "There are very few labs in the world that provide to us the education, knowledge and learning (we need)… and this is one of them." The FDA could have gone to many places, but chose this lab because of its excellence and its dedication to shaping how the world pre-clinically tests implants.

Regulators such as those at the FDA, Dr. Haider said, "… walk a fine line: Set regulations that are too slack, and some patients can get hurt. Make them too harsh, and they can hinder implementation of innovative new technologies. The FDA experts who visited Nebraska are among the most dedicated our government offers."

On the surgical technology front, the lab has received five invention patents focused, much like the Mako robot (Stryker – NJ), on facilitating 3-dimensional navigation for bone osteotomies for joint replacement and preventing deviation from a pre-surgical plan (see images on next page). Unlike the Mako robot, these innovations are incorporated onto surgical hand tools, a miniaturized navigation system with stereo cameras all on board futuristic "smart" oscillating or reciprocating bone saws or drills. The surgeon is prevented from deviating by electrical slow-down or stopping of the saw or drill in milliseconds until the position and orientation are corrected.









...and Seven Weeks for a Skip Around the World.

Over the years, Dr. Haider has been invited to speak in various parts of the world on many occasions. In the fall of 2018, he had a particularly arduous agenda of seven trips in nine weeks, four of which were overseas. He was the keynote speaker at a symposium that took place in the largest teaching hospital in south Taiwan in the city of Kaohsiung. A few days after returning to Omaha he went to San Diego to lead the U.S. delegation and to chair the local organizing committee for the ISO (Standards) meeting. It was then on to Montreal to lead a one-hour debate titled, "What is hip, metal or ceramic?" Dr. Haider commented, "I was so worried, as the debating opponent was none other than Dr. Alfons Fischer of the University of Duisburg-Essen, a world-renowned authority on metal alloys for orthopaedics. He was obviously chosen to scientifically debate for the (gold standard) metal hips, and I felt like a scientific rookie debating the other side. With much prestudy, and an over-prepared presentation, I visited and revisited the causes of the metal-on-metal hip recall saga and modular taper corrosion, and especially their effects on metal sensitive patients. With a bit of humour injected and some dramatization, I miraculously managed to turn that international audience of tribologists to my (I thought) shaky side of the debate. But the whole session was educational, illustrating the scientific arguments on both sides."

The week after, Dr. Haider went to Washington, D.C. for his role on the NIH Grants Review Panel on the Bioengineering, Technology, and Surgical Sciences (BTSS) Study Section. He then went to London for the annual congress of the International Society for Technology in Arthroplasty to participate as a member of the Board of Directors and present a paper for which he won the award for best biomechanics paper. He returned to Washington, D.C. for the biannual ASTM International meeting for writing standards and leading the U.S. Technical Advisory Group to the ISO on implants for surgery. Finally, he was an invited speaker for the Annual Congress of the Chinese Orthopaedic Association in Xiamen, China.

Grants and contracts with tens of companies, FDA recognition for excellence, research awards, patents, publications, and profound national and international links, the Biomechanics and Advanced Surgical Technologies Laboratory in the UNMC Department of Orthopaedic Surgery is now firmly one of Nebraska's gems lending pride to all current and alumni orthopaedic faculty and residents who helped make it happen.

CLINICAL **RESEARCH**

Making Advancements in Patient Care Through Clinical Research

As with any discipline, research is needed to improve outcomes. As such, the department developed an orthopaedic surgical database registry in 2005, with the purpose of ensuring that diagnosis and treatment are continually evolving and improving within the Department of Orthopaedic Surgery.

Any patient who sees an orthopaedic surgeon may be included in this database. In general, outcomes collection is initiated at the pre-operative clinic visit, during which the surgeon completes a physical examination of the affected area and the patient completes questionnaires regarding their pain, function, range of motion and quality of life. After that, patients are followed for life and their surgery outcomes are collected at regular intervals. Those who do not return for follow up visits are mailed the assessments to complete and return. Regular and consistent collection of these outcomes measurements, followed by accurate interpretation and detailed analysis, guides treatment modifications which in turn improve patient care and outcomes. To date, 8,500 surgeries at UNMC are being actively followed and provide data for numerous other specific research studies.

There are 20 faculty members and 24 residents from the Department of Orthopaedic Surgery who are named as investigators in a total of 51 human research studies. Numerous other studies are in development.

Some of our studies are large, multi-center clinical studies conducted cooperatively at multiple centers throughout the country. This allows researchers the advantage of being able to enroll a large number of subjects, which increases the generalizability of the results. For example, one such study currently underway will enroll 1,000 subjects over a 4-year period at our UNMC site alone, with a total overall enrollment of 25,000 subjects at 25 sites nationwide.

The majority of the research studies within the Department of Orthopaedic Surgery are investigator-initiated, as opposed to a pharmaceutical or device company funding, initiating and designing the investigation. Many of our investigator-initiated studies are in collaboration with other UNMC Departments (including Neurology, Cardiology, Rheumatology, Regenerative Medicine, Genetics Cell Biology & Anatomy, Pathology & Microbiology, and Infectious Disease) and various local study sites (including Children's Hospital and Medical Center; CHI Health Creighton University; Veterans Administration Hospital; Nebraska Orthopaedic Hospital, and OrthoWest). Research collaboration not only enhances the ability to share and exchange resources, but also brings together some of the brightest minds. As such, endless opportunities exist to share and learn from these complementary disciplines. Different perspectives, experience and knowledge stimulate new ideas and new approaches.

The following is a list of all active outcomes, clinical, interventional and sponsored studies in the department.

Active

- In Vitro Models of Cartilage Development, Homeostasis, and Disease
- Looking at Gender Differences in Glenoid Wear Rates Using Several Radiologic Measurements, Specifically Studying Glenoid Version, Vault Depth and Volume.
- This Research is to Generate Tissue Engineered Scaffolds with Anisotropic Structure Biochemical and Biomechanical Gradient to Stimulate Tendon Healing and Tendon-to-Bone Regeneration for the Rotator Cuff.
- Prospective observational study of donor-site morbidity following posterior iliac crest bone-graft harvest in thoracic and lumbar spinal fusion operations.
- Does Prophylactic Administration of TXA Reduce Mean Perioperative Time and Perioperative Blood Loss in Posterior Approach Lumbar Spinal Fusion Surgery Performed for Degenerative Spina Disease?
- Prospective, Randomized, Clinical Trial to Evaluate Efficacy Via VAS Scores, Length of Stay, and Narcotic Use in Morphine Equivalents Between Exparel vs Bupicaine/Marcaine vs Placebo in 2 Level Posterior Lumbar Stenosis.
- SRTM PIP Implant System Avanta Proximal Interphalangeal (PIP) Finger Joint Prosthesis
- SRTMMCP Implant System Avanta Metacarpophalangeal (MCP) Finger Joint Prosthesis
- Orthopaedic Registry to Monitor Treatment Outcomes
- Outcomes of Total Hip Replacement Utilizing Oxidized Zirconium Femoral Heads on Cross-Linked Polyethylene.
- Radiographic Outcomes of Total Hip Replacements Utilizing Cross-Linked Polyethylene.
- Clinical Function Correlates with Ideal Biomechanical Reconstruction.
- Comparative Effectiveness of Pulmonary Embolism Prevention After Hip and Knee Replacement (PEPPER): Balancing Safety and Effectiveness.
- Prevalence of Staph Aureus in Patients Undergoing Total Joint Arthroplasty and the Effectiveness of Pre-Operative Decolonization in Preventing Post-Operative Infection.
- Outcomes of Total Hip Arthroplasty for Post-Traumatic Arthritis Following Acetabular Fracture
- Manipulation Under Anesthesia (MUS) to Treat Postoperative Stiffness After Total Knee Arthroplasty
- Minimum 13-year Follow-up of Total Hip Arthroplasty with Longevity Highly Cross-Linked Polyethylene Liners.
- The Utility of Oral Antibiotic Therapy Following 2-Stage Revision Arthroplasty for Infected Prosthetic Hips and Knees.
- Identifying Current Opioid Prescription Practice and Implementing Guidelines After Total Knee and Total Hip Arthroplasty
- Understanding the Difference in the Expression of the Hedgehog Pathway Before and After Chemotherapy in Solid Tumors.
- Descriptive Analysis of the Effect of Surgeries on Human Immune Status.
- Immune Panel Repertoire
- Descriptive Analysis of the Effect of Surgeries on Human Immune Status.
- Distinguishing Commensal Versus Pathologic Staphylococcus Species in Cases of Fracture Nonunion After Internal Fixation.
- CT vs X-ray in Measuring Displacement and Angulation in Clavicle Fractures.
- An Immediate Weight-Bearing Protocol vs Stress Radiography to Determine Ankle Stability in Patients with Isolated SER Distal Fibular Fractures.
- Driving and Mobility Recovery After Right-Sided Total Knee Replacement Surgery
- Registry for Orthopaedic Trauma in Children
- Study on Incidence of Proximal Femur Fractures After Open Reduction and Internal Fixation of Distal Femur Fractures.
- Regional and Seasonal Variations in the Incidence of Post-Traumatic Infection after Open Extremity Fractures.
- Latrogenic Sciatic Nerve Dysfunction after Posterior Approach for Treatment of Acetabular Fractures with and Without Hip Dislocation.
- Postoperative Outcomes of Hip Fracture Surgery in Older Patients on Clopidogrel or Warfarin at the Time of Surgery.
- Proximal Humerus Fracture Database Registry
- Defining the Role of Head of Bed Angle in Cerebral Deoxygenation Events During Upper Extremity Surgery in the Beach Chair Position.
- Identifying Hip Fractures Using Deep Convolutional Neural Networks
- Pain Associated with Cemented and Press-Fit Long Stemmed Tibial Components in Revision Total Knee Arthroplasty.
- How Many Distal Radius Fractures Within a One-Year Time Period Would Benefit From Fixation with a Novel Device?
- Assessing Outcomes in Revision Total Shoulder Arthroplasty Using Allograft
- UNMC Rheumatology Serous/Synovial Fluids and Tissue Bank.
- Long Term Outcome and Risk of Periprosthetic Fracture in Total Hip Arthroplasty Using Uncemented Synergy Tapered Stems.
- Long Term Outcome Follow-up of Glenoid Anchor Peg Component Fixation Utilizing Autologous Bone Graft in Total Shoulder Arthroplasty.
- ACL-WALK Study
- Adductor Canal Block and the Effect on Gait.
- Sling Wear and the Effect on Gait
- Sleep Improvement and Academic Performance
- The Effect of Tourniquet Use on Quadriceps Strength and Gait in Total Knee Arthroplasty.
- Establishing a Registry of Athletic Knee Injuries
- Characterization of Movement Variability in TKA.
- The Coefficient of Friction of Human Osteoarthritis Cartilage on Joint Repair Materials Lubricated by Human Osteoarthritic Synovial Fluid.
- Longitudinal Study of Osteogenesis Imperfecta Brittle Bone Disorders Consortium
- Cross-Linked Collagen Peptides as a Urinary Biomarker of OI Pathology Brittle Bone Disorders Consortium
- CSSG Multi Center Retrospective and Observational Data Registry for Clinical and Radiographic Outcomes of Spinal Surgery Comparing Instrumentation and Procedures (K2M CSSG Data Collection Project Agreement)
- A Multicenter, Randomized, Double-Blinded Comparative Study to Evaluate the Efficacy, Safety, and Pharmacokinetics of Daptomycin Versus Active Comparator in Pediatric Subjects with Acute Hematogenous Osteomyelitis Due to Gram-Positive Organisms
- Operative Treatment of Forearm Deformities in Children with Osteogenesis Imperfecta
- Molecular Studies of Anonymous Samples from Non-BCM Investigators Involved in the Study of Skeletal Dysplasias
- Long-Term Results of Femoral and Tibial Osteotomies and Fassier-Duval Nailing in Children with Osteogenisis Imperfecta
- Pediatric: Osteogenesis Imperfecta (OI) / Metabolic Bone Data Registry

COLLABORATIVE **RESEARCH**

Collaborative Research Programs and Educational Opportunities

Multidisciplinary Progress

One of the great benefits of being part of Nebraska's only public academic health sciences center is that we can easily collaborate with the brightest minds in multiple departments to offer our patients the best in today's treatment methods. Many of our orthopaedic faculty members conduct clinical outcomes research, interventional studies and sponsored studies in conjunction with other world-class clinicians and researchers throughout the University of Nebraska Medical Center, and the results are staggering. In particular, department faculty are currently conducting collaborative research in the areas of genetic defects, staphylococcal-related infections and disease and arthritis.

The role of genetics in orthopaedic surgery

Cartilage and bone disorders that result from genetic defects, aging or injury have a major impact on quality of life and economic welfare, as do infections. Researchers from the departments of Orthopaedic Surgery, Microbiology/Pathology and Infectious Disease are collaboratively expanding the understanding of prevalent osteoarthritis and staph infections, as well as advanced treatment for these conditions, through in vitro study to replicate relevant cellular interactions and microenvironments in diseased, non-diseased and aging tissue.

Previously, model organisms helped researchers gather extensive findings on the processes of skeletal development, homeostasis and degeneration. However, those advancements have been limited by the relative lack of information about how human genetics, injury and disease disturb skeletal cell biology, endogenous repair and regeneration. With patient permission, bone, cartilage, connective tissue, marrow and synovial fluid that would otherwise be discarded are now collected and distributed to multiple laboratories across campus. (Each specimen includes patient age, gender and orthopaedic diagnosis. However, all personal identifiers are removed.) These specimens support researchers in making intelligent connections between the effects of specific molecular processes and patient observations.

Center for Staph Research

The UNMC Center for Staphylococcal Research (CSR) is the first in the nation dedicated to staphylococcal research and translational treatment strategies. A true UNMC collaborative research group, the CSR utilizes a team approach to lessen the impact of staphylococcal disease on human health. The CSR is dedicated to further understanding staph and improving the ability to prevent, diagnose and treat staph-related disease, which is the leading cause of nosocomial and implant-related infections nationwide.

The Department of Orthopaedic Surgery and Rehabilitation's research at the CSR focuses on the management of musculoskeletal infections caused by emerging multi-resistant strains of bacteria in the surgical setting. Our department is also very fortunate to be working together with researchers from Infectious Disease, as well as basic scientists from Pathology and Internal Medicine who are studying staph infections. In addition to the pathogenesis of staph infection, there is ongoing collaboration with Dr. Tammy Kielian regarding the eradication of post-arthroplasty Staphylococcus aureus biofilms, as well as Dr. Dong Wang's project for early detection and intervention of orthopaedic implant loosening using polymer theranostics.

Nebraska Arthritis Outcomes Research Center

Through a collaborative effort between the departments of rheumatology and orthopaedic surgery, researchers at the Nebraska Arthritis Outcomes Research Center (NAORC) are exploring the determinants of poor surgical outcomes among U.S. veterans with arthritis undergoing joint replacement. Results will guide the development of future preventative and operative treatments to improve outcomes for those suffering from arthritis. This information will be a unique resource for researchers and caregivers in Nebraska and elsewhere. The NAORC was established in 2007 through a generous donation by Ruth and Bill Scott, strong supporters of the Department of Orthopaedic Surgery and Rehabilitation and UNMC.

GRANTS,
FUNDS & ENDOWMENTS

The department's mission depends upon effective integration of cutting-edge scientific research, superior medical education and state-of-the-art patient care. Grants, funds and endowments are essential to our ongoing success with linking these three functions to achieve continued growth.

Research Grants

The Department of Orthopaedic Surgery's research program has earned national and international attention and accolades. Departmental faculty members conduct research in basic science, biomedical engineering, computer simulation and nano-biotechnology, in addition to clinical outcomes studies. Advances in the diagnosis, care, and prevention of diseases require years of careful scientific research. By combining outside resources and our insights, we continue to be able to offer the most advanced diagnoses and surgical treatments for our patients.

The following list includes the names, sources and funding of grants received by the Department of Orthopaedic Surgery's faculty members during late 2016, 2017 and 2018:

UNIVERSITY

2016	
Wear of Total Knee-Joint Prosthesesa	**$ 60,000**

INDUSTRY

2016	
Arthrex – Modular Interlock Evaluation of a Unicompartmental Knee Replacement	**$ 10,000**
2017	
Arthrex – Pin-on-disk UHMWPE Wear Comparison Between Titanium vs Cobalt-Chrome Orthopaedic Metal Alloys	**$ 40,000**
Arthrex – In-Vitro Study on the Initial Fixation and Micromotion of an Uncemented TKR Baseplate	**$ 60,000**
Optimotion – Constraint and Range of Motion Tests of the Optimotion CR TKA	**$ 15,400**
2018	
Optimotion – Further Constraint Testing of Modified Designs of the Optimotion Total Knee Replacement Systems	**$ 15,400**
Arthrex – P-O-D UHMWPE Wear Comparison Between Titanium vs Cobalt-Chrome Metal Alloyd Under Abrasive Conditions	**$ 15,000**
Wear Study of Conventional and Highly Crosslinked Vitamin E Stabilized UHMWPE Against Polish and Internationally Scratched CoCr Metal Femoral Hip Components	**$ 120,000**
Optimotion – An In-Vitro Wear Durability Study of Two Sizes of OptiMotion Total Knee Replacement Systems	**$ 95,600**
Arthrex-Battery of three types of mechanical tests of a new PS Total Knee Replacement system	**$ 45,200**
Arthrex-Two simulator wear tests of a new PS Total Knee Replacement System under normal and highly abrasive conditions	**$ 124,999**
Optimotion-Studying uncemented tivial tray Micromotion, bearing interlock strength and constraint of the OptiMotion Total Knee Replacement System	**$ 53,400**
TDA - Pin-on-disk wear testing of novel carbon fiber re-enforced UHMWPE for use as bearings for total joint	**$ 24,000**
Optimotion-Knee simulator wear study of a middle size posterior stabilized OptiMotion Total Knee Replacement System	**$ 50,000**

CLINICAL TRIALS

2016	
Comparative Effectiveness of Pulmonary Embolism Prevention after Hip and Knee Replacement	**$ 283,920**

FEDERAL

2018	
NIH-3D Bioprinting of Biomimetic Constructs for Rotator Cuff Augmentation	**$ 475,779**

OTHER

2017	
Brittle Bone Disorders Consortium of the Rare Disease Clinical Research Network	**$ 32,480**
2018	
Brittle Bone Disorders Consortium	**$ 45,000**

Endowments and Donations

Endowments provide much-needed perpetual resources for a variety of departmental education and research activities. When an endowed fund is established through the University of Nebraska Foundation to benefit the Department of Orthopaedic Surgery and Rehabilitation, the principal of the fund is invested and a portion of the earnings support assistantships, resident education, equipment and technology purchases, library resources, research project seed money, faculty chairmanships and much more, depending upon the donors' interests.

The department also maintains several non-endowed funds at the University of Nebraska Foundation. Our Development Fund is an unrestricted resource that provides valuable, flexible resources to make various resident- and faculty-related projects possible. This fund is used primarily for resident activities, including supporting those who present research at national meetings, bringing in visiting speakers and making graduation a memorable celebration. Over the years, other funds have also been established for various purposes.

The following is a list of currently active endowed and non-endowed funds that have been established or pledged to the department since its inception:

Roy and Leslie Guse Family Fund
Benefit and support of the department

Roy and Leslie Guse Orthopaedic Research Fund
Academic research

Dr. H. Winnett Orr Endowment for Orthopedic Research and Teaching Fund
Research and teaching supplies and materials

Chapin Endowment Research Fund
Osteoporosis research support

Frank P. Stone Professorship of Orthopaedic Surgery
Faculty support/professorship

Jean Brug Jardon Endowment Fund
Resident's library and teaching resources

Orthopaedic Surgery Department Development Fund

Robert C. Hendler, M.D., Fund
Center for Excellence in Muscular Skeletal Diseases

James R. Neff, M.D., Children's Orthopaedic Cancer and Molecular Genetics Fund
Orthopaedic surgery and rehabilitation

Dr. Foster Matchett Research Assistantships
Research assistantships

Robert G. Volz, M.D., Research Fund
Research and education

Dr. Richard and Kathryn Pettee Orthopaedic Excellence Fund
Academic research

hristina M. Hixson Endowment
Sub-fund for Research in Orthopaedic Surgery and Rehabilitation Medicine

Wayne and Eileen Ryan Orthopaedic Research Development Fund
Research, education and clinic activities

Jackson Bence, M.D., Education and Research Fund
Resident education, research and related activities

L. Thomas Hood, M.D., and Herman Frank Johnson, M.D., Excellence Fund
Faculty support/professorship

L. Thomas Hood, M.D., Professorship of Orthopaedic Surgery and Rehabilitation
Faculty support/professorship

Herman Frank Johnson, M.D., Professorship of Orthopaedic Surgery and Rehabilitation
Faculty support/professorship

James R. Neff, M.D., Musculoskeletal Fund
Establishment of James R. Neff, M.D. Chair of Musculoskeletal Oncology

John F. Connolly Resident Excellence Fund
Resident fund

Orthopaedics Research and Education Fund
Benefit and support of faculty and resident research and education

UNMC Orthopaedics Excellence Fund
Equipment and other capital needs

Operation Walk Nebraska Fund
Faculty outreach activities

James R. Neff Research Fund
Benefit and support of research

Harold and Marian Andersen Lectureship for Orthopaedic Surgery
Establishment of annual lectureship to support non-orthopaedic graduation speaker

Bill and Ruth Scott, The Nebraska Arthritis Outcomes Research Center (NAORC)
Establishment, benefit and support of the Nebraska Arthritis Outcomes Research Center

Lowell T. 'Zeke' Niebaum M.D. Chair's Fund for Excellence
Benefit and support of the department

Orthopaedic Surgery 50th Anniversary Resident Research & Education Fund
Benefit and support of the residency program

> I hope that these funds may find a way to permit the department a financial mechanism to offer a research position once again and allow some deserving medical school graduate who didn't match the initial traditional way to achieve his dream of becoming an orthopaedic surgeon. Allowing a resident to take one year off from the traditional residency and work on orthopaedic related research can bring great accomplishment to that individual and his/her co-authors and enhanced recognition to the department." – Dr. Roy Guse

FEATURED **DONORS**

ROY AND LESLIE GUSE



Roy Guse, M.D., a 1990 alumni of the Department of Orthopaedic Surgery and Rehabilitation residency program, and his wife, Leslie Guse, have generously supported the department with gifts that have enabled the creation of two departmental funds.

The Roy and Leslie Guse Family Fund will be used for the purpose of supporting the Department of Orthopaedic Surgery and Rehabilitation. The Roy and Leslie Guse Orthopaedic Research Fund is a permanent endowment that will particularly support research in the department.

"The single most important reason for setting up the two funds was to show my gratitude to the UNMC Department of Orthopaedics and Dr. Connolly for permitting me the opportunity to study and become an orthopedic surgeon," Dr. Guse said. "After two years of unsuccessful attempts to match into orthopaedics, he finally gave me the opportunity to live my dream, and for that I am eternally grateful to him, the department physicians and the office staff that educated and supported me during those five years. Without that opportunity, I would have had to choose a different and certainly less satisfying career path."

Research played an important role in Dr. Guse's residency training. He came to UNMC as a second-year research resident after completing a yearlong internship at Mount Sinai Medical Center and a medical degree from the Medical College of Wisconsin. At the time, UNMC's residency program allocated one spot each year to a resident who primarily focused on research during the traditional third year.

Dr. Guse has been part of an orthopaedic surgery practice in Lufkin, Texas, for more than 20 years. He specializes in adult reconstructive surgery of the hip and knee.

CONTRIBUTORS HONOR ROLL

Private contributions make a significant difference in the day-to-day educational opportunities, research, and clinical care proudly provided by the Department of Orthopaedic Surgery and Rehabilitation. Generous gifts from alumni, friends, foundations, corporations and faculty support various departmental programs that may not otherwise be possible. Some choose to contribute to our department-wide Development Fund, which is primarily dedicated to resident education, while others specify their gifts be applied to scholarships, research, library resources, laboratory equipment or other resources.

This honor roll alphabetically lists the names of individuals and organizations that supported the department during the 2016, 2017 and 2018 calendar years.

$10,000 and up

Dr. Chris Cornett
Dr. Miguel Daccarett
Dr. Mark Dietrich
Dr. Kevin Garvin
Dr. Roy and Leslie Guse
Dr. Curtis Hartman
Dr. Brian Hasley
Dr. M. Layne Jenson
Dr. Lowell Niebaum
Dr. Justin Siebler
Dr. Matthew Teusink

$5,000-9,999

Marian L. Andersen
Paul and Sarah Duwelius
Dr. Paul Esposito
Dr. Beau Konigsberg
Dr. Sean McGarry
Dr. Joseph Morgan
Dr. Matthew Mormino
Dr. Susan Scherl
Dr. Philipp Streubel
Dr. Maegen Wallace

$1,000-4,999

Susan and Allan Erickson
Kirk and Ruth Green
R. Michael and Sharon Mendlick
Dr. David A. & DuAnn Peterson
Dr. & Mrs. Samuel E. Smith
Steven J. Volin, M.D.

$0-999

Mr. Alfred A. Buckles
Dr. and Mrs. Justin C. Siebler
Theodore C. Yee, M.D.

The Department of Orthopaedic Surgery and Rehabilitation's faculty, residents and staff sincerely thank you for your generosity and support. If you have a question or concern related to this Honor Roll of Contributors, please contact the University of Nebraska Foundation's Omaha office, located at 2285 South 67th Street, Suite 200, Omaha, NE 68106, or call 402-502-0300.

WALL OF HONOR

Honored are those whose generosity has benefited the Department of Orthopaedic Surgery and Rehabilitation

First row, left to right:
Susan Buffett (The Sherwood Foundation)
Christina M. Hixson
Dr. Robert G. Volz
William and Ruth Scott

Second row, left to right:
Dr. Wayne and Eileen Ryan
Dr. John F. Connolly
Dr. L. Thomas and Marjorie Hood
Charles W. And Margre H. Durham

Third row, left to right:
Dr. James R. Neff and
Dr. Julia A. Bridge
Dr. Jackson J. Bence
Dr. Richard A. Pettee
Harold and Marian Andersen

Third row:
Dr. Roy and Leslie Guse



The Department of Orthopaedic Surgery and Rehabilitation's Wall of Honor permanently recognizes the remarkable individuals and organizations whose generosity has benefited departmental research, education and patient care.

The Wall of Honor was installed in 2003. A series of brushed metal plaques feature the names and etched portraits of donors who have given $100,000 or more in support of the department's mission. A brief history of Nebraska's orthopaedic program, rooted in the art and science of the field, appears in the plaque's center.

French physician and professor Nicholas de Bois Andry introduced the term "orthopaedics" in a 1741 text, along with an illustration of a crooked tree anchored to a straight stake. This image became a universal symbol for orthopaedics and an important element of the department's identity.

In Nebraska, Dr. H. Winnette Orr (1877-1956) and Dr. Robert Schrock (1884-1960) were pioneers in the field. Leading innovators for the treatment of musculoskeletal disorders in children and adults, they were also early presidents of the American Orthopaedic Association (1937) and American Academy of Orthopaedic Surgeons (1941), respectively.

Contemporary Omaha surgeons established the University of Nebraska orthopaedic resident education program in the 1960s. Today, the department continues to thrive and reach new milestones of outstanding medical education, scientific exploration and humanitarian care.



Class of 2019

Todd Gilbert, M.D.
- Hometown: Ogden, Utah
- College: Weber State University
- Medical School: Virginia Commonwealth University

Tyler Larson, M.D.
- Hometown: Rochester, Minnesota
- College: University of Minnesota Duluth
- Medical School: University of North Dakota

Eric Bowman, M.D.
- Hometown: Memphis, Tennessee
- College: University of Tennessee
- Medical School: University of Tennessee Health Science Center

Ryan Miller, M.D.
- Hometown: Fullerton, California
- College: University of California, Irvine
- Medical School: Creighton University Medical Center

MEET OUR RESIDENTS

Class of 2020



Kent Rinehart, M.D.
- Hometown: Knoxville, Tennessee
- College: University of Tennessee
- Medical School: East Tennessee State University Quillen College of Medicine

Phillip Thomas, M.D.
- Hometown: Minneapolis-Saint Paul, Minnesota
- College: Saint Mary's University of Minnesota
- Medical School: University of Minnesota Twin Cities

Christopher Deans, M.D.
- Hometown: Hemingford, Nebraska; graduated high school in Denver, Colorado
- College: University of Northern Colorado and University of Nebraska at Kearney
- Medical School: University of Nebraska Medical Center

David Kusin, M.D.
- Hometown: Houston, Texas
- College: Yeshiva University
- Medical School: Case Western Reserve University

Josh Cameron, M.D.
- Hometown: Midwest City, Oklahoma
- College: University of Oklahoma
- Medical School: University of Oklahoma Health Sciences Center

Emmett Gannon, M.D.
- Hometown: Kearney, Nebraska
- College: University of Nebraska at Kearney
- Medical School: University of Nebraska Medical Center

Joshua Locker, M.D.
- Hometown: Orange City, Iowa
- College: Northwestern College
- Medical School: University of Iowa Carver College of Medicine

Daniel Sveom, M.D.
- Hometown: Staples, Minnesota
- College: Wartburg College
- Medical School: University of Minnesota Medical School

Darin Larson, M.D.
- Hometown: Vincent, Iowa
- College: University of Iowa
- Medical School: University of Iowa Carver College of Medicine

Evan Larson, M.D.
- Hometown: Bode, Iowa
- College: University of Iowa
- Medical School: University of Iowa Carver College of Medicine

Class of 2021



OUR **RESIDENTS**



Class of 2022

Gordon Roedel, M.D.
- Hometown: Loyal, Wisconsin
- College: Wartburg College
- Medical School: University of Wisconsin School of Medicine and Public Health

David Brown, M.D.
- Hometown: Friendswood, Texas
- College: The University of Texas at Austin
- Medical School: University of Texas Medical Branch

Zachary Bailey, M.D.
- Hometown: Cincinnati, Ohio
- College: University of Nebraska – Lincoln
- Medical School: University of Nebraska Medical Center

Matthew Tingle, M.D.
- Hometown: Lee's Summit, Missouri
- College: University of Kansas
- Medical School: University of Kansas School of Medicine

Jace Heiden, M.D.
- Hometown: Bertrand, Nebraska
- College: Nebraska Wesleyan University
- Medical School: University of Nebraska Medical Center

Brandon Bennett, M.D.
- Hometown: Gretna, Nebraska
- College: University of Nebraska at Omaha
- Medical School: University of Nebraska Medical Center

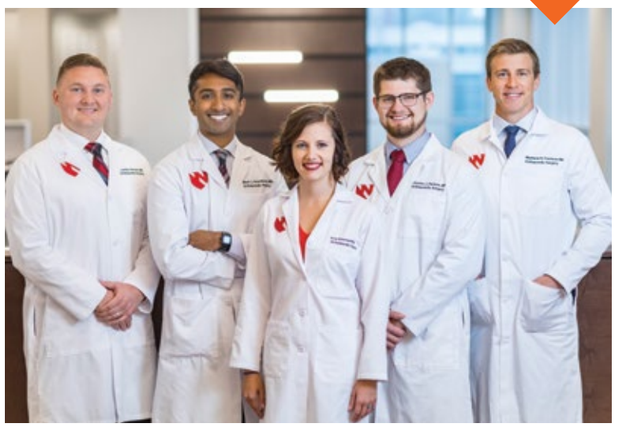
Mark Amirtharaj, M.D.
- Hometown: Germantown, Maryland
- College: University of Maryland, College Park
- Medical School: Georgetown University School of Medicine

Erin Stockwell, M.D.
- Hometown: Bonners Ferry, Idaho
- College: Arizona State University
- Medical School: University of Arizona College of Medicine – Phoenix

Charles (CJ) Hansen, M.D.
- Hometown: Kokomo, Indiana
- College: Indiana University Bloomington
- Medical School: Indiana University School of Medicine

Matthew Freeman, M.D.
- Hometown: Elkhorn, Nebraska
- College: University of Nebraska – Lincoln
- Medical School: University of Nebraska Medical Center

Class of 2023



RECENT **POST-GRADUATE** FELLOWSHIPS AND PRACTICES

After completing five years of residency training at UNMC, our residents move on to the next phase in their medical careers. Many choose to continue their education in post-graduate fellowships at various schools or practices around the country. Others opt to begin their careers in general orthopaedic surgery at the practice of their choice. Our most recent graduates and their chosen fellowships and practices are listed below.



Class of 2017

Paul Johnson, M.D.
- Spine Surgery Fellowship
  University of Pittsburgh, Pittsburgh, PA

Andrew Kirkpatrick, M.D.
- Hand Surgery Fellowship
  University of Massachusetts, Worcester, MA

Eric Bonness, M.D.
- Shoulder and Elbow Surgery Fellowship
- Boston Shoulder Institute, Boston, MA

Courtney Grimsrud, M.D.
- Foot and Ankle Surgery Fellowship
- University of Washington, Seattle, WA



Class of 2018

Leonid Grossman, M.D.
- Orthopaedic Trauma Fellowship
- University of Pittsburgh, Pittsburgh, PA

Sayfe Jassim, M.D.
- Adult Reconstructive Fellowship
- The CORE Institute, Phoenix, AZ

Benjamin Ogden, M.D.
- Hand and Upper Extremity Fellowship
- Florida Orthopaedic Institute, Tampa, FL

Noah Porter, M.D.
- Spine Fellowship
- University of Pittsburgh, Pittsburgh, PA

EDUCATING THE **NEXT GENERATION**

The Nebraska Orthopaedic Residency Training Program

In the 50 years since UNMC sent its first newly-trained orthopaedic surgeon out into the world, the residency program in the Department of Orthopaedic Surgery has transformed into one of the top programs in the country. Today, the program includes 25 budding orthopaedic surgeons, all of whom come from exceptional medical school backgrounds and are poised to become the best and brightest in the field of orthopaedics.

Life as an orthopaedic resident is a rigorous, but rewarding experience. Each day, the residents at UNMC can be found actively caring for patients, consulting on diagnoses and treatment plans, assisting in the operating room and conducting important research. They spend five years of their lives in Omaha, undergoing intense training in each of the nine orthopaedic subspecialties:

- hand and upper extremity
- foot and ankle
- major joint reconstruction
- oncology
- pediatric orthopaedic surgery
- shoulder and elbow
- spine
- sports medicine
- trauma

The Nebraska Orthopaedic Residency Training Program partners closely with Nebraska Medicine, a Level I trauma center, and the state's largest and highest rated hospital. Through this partnership, UNMC residents orthopaedic surgery residents are often the first physicians called to the emergency department in the event of a patient trauma in Omaha or the surrounding community.

Residents also benefit from the program's affiliation with Children's Hospital & Medical Center, Omaha Veterans Affairs Medical Center, Nebraska Orthopaedic Hospital and Bergan Mercy Medical Center.

The program received full accreditation by the Residency Review Committee of the Accreditation Council for Graduate Medical Education (ACGME) in January 2009 and is aligned with the American Academy of Orthopaedic Surgeons (AAOS) requirements. UNMC's residency curriculum addresses the six core competencies: patient care, interpersonal and communication skills, professionalism, medical knowledge, systems-based practice and practice-based learning and improvement.

Twenty-two full-time clinical and research faculty and numerous staff members are closely involved in every aspect of resident education. These educators instruct, evaluate and mentor residents throughout their tenure at UNMC. Full-time lab technicians and clinical research coordinators also step in to assist with required research projects. Part-time and volunteer faculty members from the Omaha area provide additional educational opportunities as residents explore the various options open to them as orthopaedic surgeons.

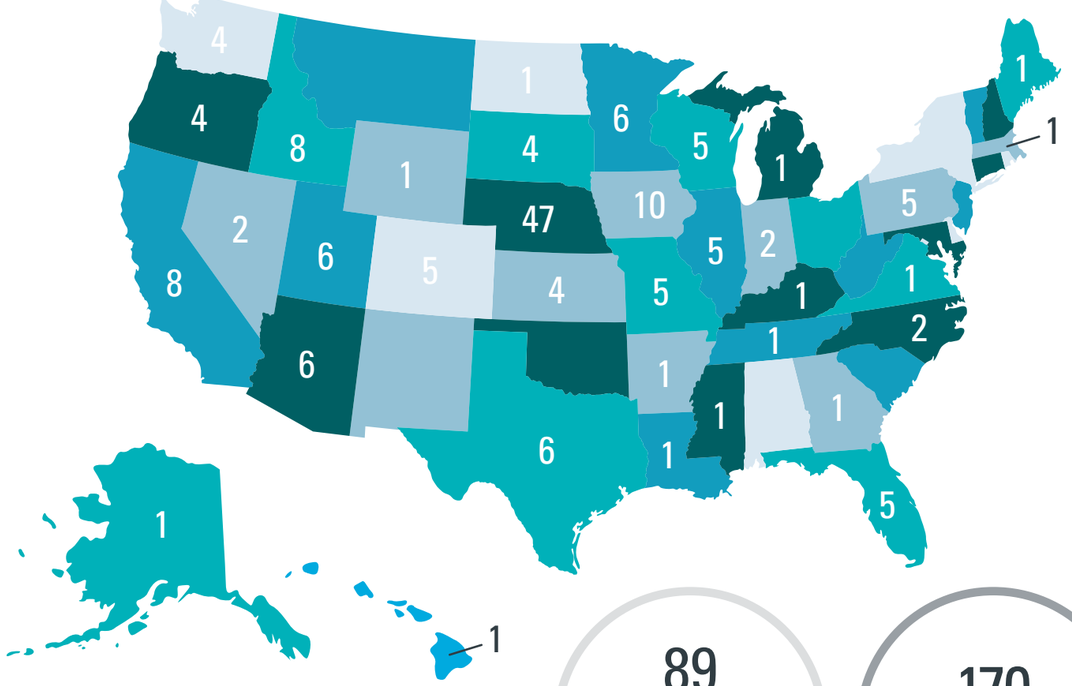
Early on in their training, residents are also exposed to subspecialty private practice environments, where they can get a feel for providing care as a private practitioner, in addition to their robust training in academic medicine.

The Nebraska Orthopaedic Residency Training Program is directed by Matthew Mormino, M.D., professor of orthopaedic surgery at UNMC. Omaha's metropolitan area is home to nearly 900,000 people and counting, and offers residents the chance to receive an outstanding educational experience while living in a safe town with affordable living and an enriched social environment. As such, many of UNMC's residents eventually go on to build their orthopaedic practices in Nebraska and the Midwest.

NEBRASKA ORTHOPAEDIC ALUMNI

The following is a list of all department alumni since the orthopaedic residency program was established in 1969.

We are proud that more than half of the men and women who have completed their orthopaedic residency training through UNMC have continued their careers in Nebraska or the Midwest. The remaining physicians are practicing around the country and overseas, and many have gone on to become educators themselves, passing on their skills and knowledge to the next generation of physicians. Doctors throughout the region regard UNMC as a source of continuing education where they can learn the latest techniques for diagnosis, treatment, and prevention of bone and joint diseases.



89
ALUMNI PRACTICING IN NEBRASKA & THE MIDWEST

170
TOTAL ALUMNI

NAME	STATE	YEAR
Lowell Niebaum	NV	1971
Dale Phelps**		1972
Oscar Jardon**		1972
William Smith*		1973
Carl Schwartz		1973
Richard Bergstrom	NE	1974
Ronald Boulware	TX	1974
John Kaufman	CA	1974
Robert Staver	OR	1974
James Kullbom	SD	1975
Robert Cochran, II	NE	1975
Richard Wecker	WY	1975
Floyd Pohlman	HI	1976
Jack Brindley	IA	1977
Neil Halbridge	CA	1978
Eric Bugna	CA	1978
William Boulden	IA	1978
John Yeakley	NE	1979
Jasper Williams	WI	1979
Ronald Schwab	NE	1979
Barry Turner	NE	1980
Samar Ray	NE	1980
Alois Proett	WI	1980
Joel Adams	ME	1981
Edward Simodynes**		1981
Donald Walla	NE	1982
Ram Pankaj	IL	1982
Gurpal Bhuller	VA	1982
Randall Neumann	NE	1983
Gary Porubsky	LA	1983
Gregg Taylor	WI	1983
Mark Buchman	NE	1984
Michael Schmidt	KS	1984
Christeen Kaga	NC	1984
Mark Secor	KY	1984
Scott Smith	UT	1985
Robert Hansen	UT	1985
John Kelbel	IN	1985
Joseph Yao	AR	1986
Thomas Eastman	TX	1986
Larry Chidgey	FL	1986
F. Stig Jacobsen	MN	1986
Lewis Oster, Jr.	CO	1987
Kirk Green	IA	1987
Paul Duwelius	OR	1987
David Buck	NE	1987
Marcia Beckman-Nelsen*		1988
Richard Shindell	AZ	1988
Gregory Hansen**		1988
Jeffrey Farber	IA	1988
Jan Davis	CO	1989
Lynn Crosby	NE	1989
Samuel Smith	CO	1989
Robert Dehne	TX	1989
Bryan Bredthauer	NE	1990
Kevin O'Malley	NE	1990
Michael Sicuranza	PA	1990

NAME	STATE	YEAR
Roy Guse	TX	1990
Douglas Beard	CO	1991
Teri Formanek	IA	1991
Bret Miller	IL	1991
Mark Goebel	NE	1991
Thomas Walsh	MN	1992
Jeffrey Moore	AK	1992
David Thull	AZ	1992
Jeffrey Tiedeman	NE	1992
Todd Kile	AZ	1993
Jeffrey Davick	IA	1993
Eric Gordon	MO	1993
Scott Beck	FL	1994
Ted Yee	CA	1994
Scott McMullen	NE	1994
James Hill	IL	1994
Robert Tait	NV	1994
Deepak Chavda	TX	1995
Robert Mileski	AZ	1995
Vern Prochaska	NE	1995
Clay Frank	WI	1995
John Miyano	WA	1996
Matthew Mormino	NE	1996
Julian Arroyo	WA	1996
Jeffrey Rodgers	IA	1996
Keith Hughes	NE	1997
Steven Kumagai	NE	1997
David Castro	CA	1997
Khiem Dao	CA	1997
John McClellan, III	NE	1998
Charles Burt	NE	1998
Michael Sochacki	AZ	1998
Brett Fischer	NE	1998
Jeffrey Zacharias	MI	1999
Stanley Bowling	KS	1999
Daniel Hoeffel	MN	1999
Erik Otterberg	NE	1999
Brian Brigman	NC	2000
Eric Watson	SD	2000
Edward Fehringer	NE	2000
John Schneider	WI	2000
Armodios Hatzidakis	CO	2001
Craig Mahoney	IA	2001
Michael Clare	FL	2001
Aaron Askew	OR	2001
Michael Thompson	NE	2002
James Ballard	OR	2002
David Inda	NE	2002
Douglas McInnis	ID	2002
Kristoffer Breien	MN	2003
Joshua Urban	NE	2003
Jason Browdy	MO	2003
John Sojka	KS	2003
Stephen Hansen	ID	2004
Brian Hasley	NE	2004
Richard Davis	ID	2004
Lori Reed	MS	2004

NAME	STATE	YEAR
Anthony Lauder	WA	2005
Scott Humphrey	ID	2005
Edward Prince	UT	2005
Ivan Tarkin	PA	2005
Charles Rosipal	NE	2006
Daniel Mulconrey	IL	2006
Mark Dietrich	NE	2006
Steven Volin	NE	2006
Kathleen Grier	NE	2006
Scott Swanson	NE	2007
David Buck	NE	2007
Kimberly Turman	NE	2007
Beau Konigsberg	NE	2007
Curtis Hartman	NE	2008
Randon Johnson	IL	2008
Leonard Kibuule	TX	2008
Michael Hawks	FL	2008
Erica Burns	WA	2009
Casey Johnston	SD	2009
Brian Kleiber	MO	2009
Justin Siebler	NE	2009
Kurt Bormann	MO	2010
Ryan Arnold	NE	2010
Michael Shevlin	ID	2010
Gustavo Cordero	CA	2010
Michael Carlson	UT	2011
Jason Erpelding	ND	2011
Michael Dee	UT	2011
Daniel Firestone	NE	2011
Ryan Hess	MN	2012
Nicholas Aberle, II	KS	2012
Lucas Burton	TN	2012
Brian Vernon	UT	2012
Jeremy Toomey	ID	2013
Nolan May	NE	2013
Ann Knierim	ID	2013
Eric Samuelson	NE	2013
Khalid Azzam	IN	2014
David Minges	MO	2014
Kevin Lindgren	MN	2014
Brent Hood	NE	2015
Andrew Taiber	IA	2015
Gregory Dammann	IL	2015
Todd Gaddie	NE	2015
Paul Nielsen	NE	2016
Scott Vincent	NE	2016
Kaitlin Neary	ID	2016
Paul Hong	CA	2016
Eric Bonness	MA	2017
Courtney Grimsrud	SD	2017
Paul Johnson	PA	2017
Andrew Kirkpatrick	MA	2017
Noah Porter	PA	2018
Benjamin Ogden	FL	2018
Sayfe Jassim	AZ	2018
Lenoid Grossman	PA	2018

*Unable to contact **Deceased

September 2016

12 **Ronalee Vinsonhaler CPC**
Professional Coding Senior Associate, UNMC

"Orthopaedic Billing and Coding"

16 **Matthew Teusink, M.D.**
Assistant Professor, UNMC Department of Orthopaedic Surgery & UNMC Musculoskeletal Radiologists

"MRI of the Shoulder"

19 **Christopher Gillis, M.D.**
Assistant Professor, UNMC Department of Surgery

"Minimally Invasive Spine Surgery"

26 **Jennifer Yalof, Psy.D.**
Adjunct Professor, UNMC Department of Psychiatry

"Physician Wellness"

October 2016

10 **Sara May, M.D.**
Assistant Professor, UNMC Department of Internal Medicine

"No More Vanco"

December 2016

2 **Kristie Hadden, Ph.D.**
Executive Director and Principal Investigator for Center for Health Literacy, University of Arkansas for Medical Sciences

"Health Literacy in Orthopaedics"

C. Lowry Barnes, M.D.
Professor, University of Arkansas for Medical Sciences

"Value Based Orthopaedics: The Future is Here"

21 **Chris Hogrefe, M.D.**
Assistant Professor, Northwestern University Feinberg School of Medicine
Team Physician, Chicago Cubs

"Avoiding a Farewell to Arms: The evaluation and Management of the Youth Thrower"

February 2017

17 **Matthew Teusink, M.D.**
Assistant Professor, UNMC Department of Orthopaedic Surgery, & UNMC Radiologists

"MRI Radiology Correlation"

March 2017

6 **Dr. Steven P. Wengel**
Professor, Chairman, UNMC Department of Psychiatry

"Physician Burnout: What It's Doing to Your Brain and What We Can Do About It"

8 **Children's Hospital Radiologists**

"Radiology Conference"

April 2017

10 **Jason Shiffermiller, M.D.**
Assistant Professor, UNMC Department of Internal Medicine

Thomas Nicholas, M.D.
Associate Professor, UNMC Department of Anesthesiology

"Inpatient Acute Pain Management"

May 2017

12 **Matthew Teusink, M.D.**
Assistant Professor, UNMC Department of Orthopaedic Surgery & UNMC Musculoskeletal Radiologists

"Radiology Correlation"

24 **Kody Moffatt, M.D.**
Adjunct Associate Professor, UNMC Departmentof Orthopaedic Surgery

"Overuse injuries in children"

June 2017

9 **James Stannard, M.D.**
Hansjörg Wyss Distinguished Chair in Orthopaedic Surgery, University of Missouri School of Medicine

"Stand in the Door: Leadership and Life Lessons from the 82nd Airborne Division"

Alexis Ohanian

"The Promise of the Internet"

10 **James Stannard, M.D.**
Hansjörg Wyss Distinguished Chair in Orthopaedic Surgery, University of Missouri School of Medicine

"Biologic Joint Replacement"

August 2017

9 **Kari Simonsen, M.D.**
Pediatric Infectious Diseases, Children's Hospital

"Septic arthritis, myositis and osteomyelitis"

18 **Rusty McKune**
Sports Medicine Program Coordinator, Nebraska Medicine

"Fall Football"

21 **Nicole Dewit**
Applications Training Lead, Nebraska Medicine

"One Chart New Version Training"

September 2017

13 **Megan Moore**
CPO, Hanger Prosthetics

"Prosthetics & Orthotics"

18 **Terri Reeves, RHIA, CCS-P, CPC**
Professional Coding Manager, Nebraska Medicine

"Updates on Coding/Compliance/Billing"

20 **Andria Powers, M.D.**
Assistant Professor, UNMC Department of Radiology

"Radiology Conference"

22 **Matthew Teusink, M.D.**
Assistant Professor, UNMC Department of Orthopaedic Surgery, & UNMC Radiologists

"Radiology-Arthroscopy Correlation"

29 **Paul Anderson, M.D.**
Professor of Orthopaedic Surgery, University of Wisconsin

"Linkage of Osteoporosis and Periprosthetic Fractures: Research Methodology"

October 2017

23 **Laura Graeff-Armas, M.D.**
Associate Professor, UNMC Department of Internal Medicine

"Osteoporosis Update"

November 2017

15 **Andria Powers, M.D.**
Assistant Professor, UNMC Department of Radiology

"Radiology Conference"

17 **Nebraska Medicine Physical Therapy Department**

"Physical Therapy for Sports Injuries"

January 2018

17 **Andria Powers, M.D.**
Assistant Professor, UNMC Department of Radiology

"Radiology Conference"

31 **Kody Moffatt, M.D.**
Adjunct Associate Professor, UNMC Department of Orthopaedic Surgery

"Concussions"

February 2018

16 **Matthew Teusink, M.D.**
Assistant Professor, UNMC Department of Orthopaedic Surgery, & UNMC Radiologists

"Radiology Correlation Conference – Shoulder"

March 2018

23 **Matthew Teusink, M.D.**
Assistant Professor, UNMC Department of Orthopaedic Surgery, & UNMC Radiologists

"Shoulder Arthroscopy & MRI Conference"

April 2018

11 **Andria Powers, M.D.**
Assistant Professor, UNMC Department of Radiology

"Radiology Conference"

13 **Bret Woslager, DPT**
Nebraska Medicine Physical Therapist

"Shoulder Rehab"

30 **Dr. Alison Toth**
Associate Professor, Sports Medicine, Duke University, North Carolina

"Articular Cartilage Repair Options for the Knee in 2018 and Potential Biologic Modifiers for Post-Traumatic Osteoarthritis (OA) Prevention"

May 2018

16 **Jessica Goeller, D.O.**
Assistant Professor, UNMC Department of Anesthesiology

"Pediatric Anesthesia, Pain Management"

June 2018

1 **Nebraska Medicine Physical Therapists**

"Physical Therapy Lecture"

8 **Mary Whyte**

"Living Your Best Creative Life"

8-9 **Evan Flatow, M.D.**
Professor of Orthopaedic Surgery, Mount Sinai West

"Controversies in Shoulder Replacement" and "Emerging Trends in Proximal Humerus Fractures"

September 2018

28 **Terry Light, M.D.**
Professor of Orthopaedic Surgery, Loyola University Stritch School of Medicine

"Physeal Tethers of Growth in the Hand, Wrist and Forearm"

2016-2018
VISITING SPEAKERS

The Department of Orthopaedic Surgery hosts speakers from around the region, country and world to engage faculty, residents, staff and peers. By sharing their knowledge and expertise in a variety of disciplines, these visitors enhance the lifelong educational experience fostered by UNMC and the department.

These guest presentations are made possible by generous contributions to the department's Development Fund from alumni and supporters. This support allows us to continue bringing visiting speakers that offer new and innovative ideas in surgical techniques, research topics and patient care.

The following list includes those who presented to the department from 2016-2018.

FACULTY **ACTIVITIES**

KEVIN L. GARVIN, M.D., CHAIRMAN

Adult Reconstructive Surgery

Kevin L. Garvin, M.D. is professor and chair of the University of Nebraska Medical Center's Department of Orthopaedic Surgery and Rehabilitation, as well as the L. Thomas Hood, M.D., Professor of Orthopaedic Surgery and Rehabilitation. He received his medical degree at the Medical College of Wisconsin in 1982. He then completed an orthopaedic surgery residency program at the University of Arkansas for Medical Sciences in Little Rock (1987) and a fellowship in hip surgery at the Hospital for Special Surgery in New York City (1988). He is a board-certified orthopaedic surgeon.

Dr. Garvin is a member of the American Academy of Orthopaedic Surgeons (member, Board of Councilors, 1993-1999; chair, Committee on Infection, 1998-2000; member, Committee on Hip and Knee Evaluation, 1995-2003; member, Board Maintenance of Certification, 2006-2008; member, Adult Reconstruction Knee Program Subcommittee, 2009-2012; member, Adult Reconstruction Hip Program Subcommittee, 2012-2016; member, Board of Specialty Societies, 2009-2017).

He is also a member of the American Orthopaedic Association (ABC Traveling Fellow, 1995; chair, ASEAN International Traveling Fellows, 2001-2002; member, ABC Traveling Fellows Selection Committee, 2002-2005; chair, Resident Leadership Forum, 2007-2008; member, Council of Orthopaedic Residency Directors Board, 2009- 2012; member, Membership Committee, 2010-2015; chair, Membership Committee, 2014-2015; delegate-at-large 2017-2018), The Hip Society (member, membership committee, 2002-2004, chair, membership committee, 2005-2006, member-at-large, Board of Directors, 2008-2009; chair, Education Committee, 2013-2014; treasurer, 2014-2015; second vice president, 2015-2016; first vice president, 2016-2017, president 2017-2018), The Knee Society (member, Nominating Committee, 2010-2012; chair, Research Committee, 2012-2015; co-investigator, Strategies to Improve Total Knee Arthroplasty, 2016; member, Membership Committee, 2015-2017; chair, Membership Committee, 2017-2018), the International Hip Society, the Association of Bone and Joint Surgeons and the Mid-America Orthopaedic Association (president, 2004-2005).

From 2016-2018, Dr. Garvin gave more than 70 presentations at local, regional, national and international conferences and institutions. He has served as associate editor for the *Journal of Bone and Joint Surgery*, as well as deputy editor for *Clinical Orthopaedics and Related Research (CORR)*, and continues to serve as a consultant reviewer for both publications, as well as for the *European Journal of Epidemiology, The Knee the British Bone and Joint Journal, and Annals of Joint.* In 2015, he was named a Top Reviewer by the CORR Board of Trustees. He has been selected as one of the Best Doctors in America from 1996-2018 and one of America's Top Doctors by Castle Connolly Medical, Ltd., from 2007-2018.

Current Research Grants:

Pellegrini, V.; **Garvin, K.**: Comparative Effectiveness of Pulmonary Embolism Prevention after Hip and Knee Replacement: Balancing Safety and Efficacy, Medical University of South Carolina/PCORI. 2016-2020. Pellegrini, V (PI); Garvin, K (CI).

Kielian, T. **Hartman, C. Garvin, K.** A Study of the Effect of Surgeries on Human Immune Status. Pfizer, Inc. 2014 – 2018

Wang, D. Garvin, K.: Early Detection and Intervention of Orthopaedic Implant Loosening using Polymer Theranostics. DHHS/NIH/NIAMS. 2013-2017 Wang, D (PI); Garvin, K (CI).

Alexander, D. **Ianno, N Garvin K**: Preventing Biofilm Growth on Metal Alloys used for Medical Implants and Devices by Femtosecond Laser Surface Processing Techniques. Nebraska Research Initiative. 2015-2017. Alexander, D (PI); Ianno N (CI); Garvin, K (CI).

Refereed Articles:

Garvin, K. : (2018). Commentary and Perspective. Spinopelvic Stiffness and the Lax Hip Arthroplasty: A Conundrum for the Aging. Jour of Bone and Joint Surg, 2018;100:e140(1-2).

Garvin, K.: (2018). Commentary: Supervised and Independent Post-Discharge Rehabilitation Did Not Differ for Improving Pain and Function after Unilateral Total Hip Replacement. JBJS, 100(16)1433, 2018

Heim, C; Vidlak, D; Odvody, J; **Hartman, C; Garvin, K.**; Kielian, T: (2018). Human Prosthetic Joint Infections are Associated with Myeloid-derived Suppressor Cells (MDSCS's): Implications for Infection Persistence. Journal of Orthopaedic Research; 36(6), pp 1605-1613.

Garvin, K.: (2018). CORR Insights: Dual-Mobility Constructs in Revision THA Reduced Dislocation, Re-Revision & Reoperation Compared to Large Femoral Heads, Accepted to Clin Orthop Rel Res, Feb; 476(2):302-304, 2018.

Garvin, K.: (2018). CORR Insights: Otto Aufranc Award Dual-Mobility Constructs in Revision THA Reduced Dislocation, Re-Revision and Reoperation Compared with Large Femoral Heads. Clin Orthop Rel Res, (476):302-304, 2018.

Haider, H., Weisenburger, J.N., Namavar, F., **Garvin, K.**: (2017). "Why Coating Technologies for Hip Replacement Systems, and the Importance of Testing Them In Vitro", Journal of Operative Techniques in Orthopaedics, 2017, ISSN 1048-6666

Wei X., Li F., Zhao G., Chhonker Y., Averill C., Galdamez J., Purdue P., Wang X., Fehringer E., **Garvin K.**, Goldring S., Alnouti Y., Wang D. (2017). Pharmacokinetic and Biodistribution Studies of HPMA Copolymer Conjugates in an Aseptic Implant Loosening Mouse Model. *Mol Pharm.*

Garvin, K., Wright, T. (2017). Strategies to improve total knee arthroplasty: A multidisciplinary research conference. *Journal of the American Academy of Orthopaedic Surgeons*, 25, S1-S3.

Haider, H., Weisenburger, J., **Garvin, K.**: (2016). Simultaneous measurement of friction and wear in hip simulators. Journal of Engineering in Medicine, Proceedings of the Institution of Mechanical Engineers, Part H: 230(5), 373-388.

Frank, J.M., Kayupov, E., Moric, M., Segreti, J., Hansen, E., Hartman, C., Okroj, K., Belden, K., Roslund, B., Silibovsky, R., Parvizi, J., Della Valle, C.J., The Knee Society Research Group, Sporer, S.M., Austin, M.S., **Garvin, K.**, Vail, T., Backstein, D., Tan, T., Dalury, D., Mont, M.A.: (2017). The Mark Coventry, MD, Award: Oral Antibiotics Reduce Reinfection After Two-Stage Exchange: A Multicenter, Randomized Controlled Trial. Clin Orthop Rel Res, 475 (1), pp. 56-61.

Book Chapter and Reviews:

Garvin, K.L., Hartman, C.W. Primary THA: Preoperative Planning and Templating. Advanced Reconstruction Hip 2, Eds: Jay R. Lieberman and Daniel J. Berry. Chicago, IL, The American Academy of Orthopaedic Surgeons, Chapter 7, pp 73-78, (2017).

Garvin continued

Lombardi Jr., A.V., Richardson, A., **Garvin, K.** (2016). Complications, Disadvantages and Readmission Rates versus Non-Rapid Recovery in Total Hip Arthroplasty. In *Orthopaedic Knowledge Update: Hip and Knee Reconstruction Vol. 5*, American Academy of Orthopaedic Surgeons, Chicago, IL. Mont, M., Tanzer, M. (Eds.) Chapter 33: 437-451.

Garvin, K., Hartman, C.W., Konigsberg, B.S.: Late Infections of the Hip Joint: Resection Arthroplasty and Other Solutions. Eds: Kendoff, D., Morgan-Jones, R. and Haddad, F. *Periprosthetic Joint Infections: Changing Paradigms*, Published by Springer Science + Business Media, May 2016, Chapter 17, pp 201-208.

Hartman, C.W., **Garvin, K**: Preventing Sepsis in Total Hip Replacement. Eds: Callaghan J, Rosenberg A, Rubash H, Beaule P, Clohisy J, Della Valle C. *The Adult Hip, Third ed.*, Published by Wolters Kluwer Health, Philadelphia, PA, June 2016, Volume 1, Chapter 51, pp 684-689.

Honors, Awards and Offices Held:

- Board Member, Omaha Sports Commission, Omaha, NE 2007-present
- Board of Trustees, University of South Dakota Foundation, 2006-present
- Past-President of The Hip Society, March 2018-present
- Chair, Membership Committee, The Knee Society, September 2017-September 2018
- Board of Specialty Societies, American Academy of Orthopaedic Surgeons, March 2016-present
- Member, Board of Directors, American Board of Orthopaedic Surgery, 2018-present
- Nebraska Medicine:
  - Clinical Chairs Advisory Board, July 2016-present
  - Perioperative Executive Committee, Jan. 2015-present
  - Ambulatory Project Executive Committee, 2014-present
  - Strategic Investment Group, 2015-present
- Dissertation Committee Member, Xin Wei, Ph.D. UNMC Student, College of Pharmacy, 2014-2018
- Oral Examiner Part II, American Board of Orthopaedic Surgery
- Editorial Board Member, *Techniques in Knee Surgery*, 2002-present
- Consultant Reviewer:
  - *Annals of Joint, April 2018 – present*
  - *British Bone and Joint Journal, Nov. 2014-present*
  - *The Knee, March 2012-present*
  - *European Journal of Epidemiology, 1995-present*
  - *Clinical Orthopaedics and Related Research, 1991-present*
  - *Journal of Bone and Joint Surgery, 1990-present*
  - *Annals of Joint, September 2018-present*

CHRIS A. CORNETT, M.D.

Adult Spine Surgery

Chris A. Cornett, M.D., is a board-certified orthopaedic surgeon. He is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation, and medical director of Physical and Occupational Therapy at Nebraska Medicine – Nebraska Medical Center and Bellevue. Dr. Cornett received his master's degree in physical therapy (2001) and medical degree (2005) from the University of Nebraska Medical Center. He completed both an orthopaedic surgery internship and orthopaedic surgery residency at the University of Wisconsin Hospital and Clinics in Madison, WI, in 2006 and 2010, respectively. Following residency, Dr. Cornett completed a spine surgery fellowship at the University of Pittsburgh Medical Center in 2011. He is a member of the American Academy of Orthopaedic Surgeons, the North American Spine Society and the Nebraska Orthopedic Society. He also serves on the Physician Advisory Team and is the OneChart Department Deputy for Orthopaedics, Medical Director of the Spine Program at Nebraska Medicine, and Medical Director for Physical Therapy and Occupational Therapy at Nebraska Medicine.

Refereed Articles:

Toy, J., **Cornett, C.**, Lee J. (2016). Cervical Spondylotic Myelopathy. *UPMC Orthopaedic Surgery Grand Rounds Publication.*

Gannon, E., **Cornett, C.**, Larson, E., Lyden, E. (2018). The Efficacy of Liposomal Bupivacaine in Lumbar Spine Surgery. *HSOA Journal of Surgery: Current Trends & Innovations.* Vol. 2 (1): p. 1-7

Jackson, J III., Vincent, S., Phelps, K., **Cornett, C.**, Grabowski, G., Scannell, B., Stotts, A., Bice, M. (2018). A Prospective Multicenter Evaluation of the Value of the On-Call Orthopedic Resident. *Journal of Graduate Medical Education.* Vol. 10 (1): p. 91-94

Book Chapter and Reviews:

Cornett, C., Kang, J., Lee, J., Devin, C., Gannon, E., Kim, E., Esmende, S. (2017). Surgical Management of Cervical Spondylotic Myelopathy. In *Instructional Course Lectures Vol. 66*, American Academy of Orthopaedic Surgeons, Chicago, IL. Gerlinger, T., Parvizi, J. (Eds.) Chapter 26.

Honors, Awards and Offices Held:

- Faculty, Faculty Senate, UNMC, 2018-2021
- Distinguished Alumni Award, Cambridge Public Schools, Cambridge, NE, April 2017
- Board Member, Journal of Orthopaedics and Physical Therapy, 2017-Present
- Member, Continuing Medical Education Committee, UNMC,2016-present
- Nebraska Medicine:
  - Medical Director, Spine Program, 2017-Present
  - Committee Member, Surgical Services Operations Committee, 2017-Present
  - One Chart Operational Owner, Dec. 2015-present
  - Provider Advisory Group for Patient Experience, November 2015-present
  - Medical Director of Physical and Occupational Therapy, The Nebraska Medical Center and Bellevue Medical Center, 2014-present
  - Physician Advisory Team Committee, 2013-present
  - Department Deputy for Orthopaedics, One Chart, 2013-present

Consultant Reviewer:

- *Pain Medicine*, 2016-present
- *Journal of Orthopaedic Research*, October 2015-present
- *Clinical Orthopaedics and Related Research*, 2014-present

PAUL W. ESPOSITO, M.D.

Pediatric Orthopaedic Surgery

Paul W. Esposito, M.D., is a professor of Orthopaedic Surgery and Pediatrics at the University of Nebraska College of Medicine. He was also awarded the Barbara & Ronald W. Schaefer Endowed Chair of Pediatric Orthopaedic Surgery at the University of Nebraska Medical Center in 2015. Dr. Esposito received his medical degree from Hahnemann Medical College and Hospital in Philadelphia in 1977, and completed his internship and residency in orthopaedic surgery at the U.S. Naval Hospital in Oakland, California (1978 and 1983, respectively). He then completed a pediatric orthopaedic fellowship at Children's Hospital Medical Center in Cincinnati in 1983. Dr. Esposito is a board-certified orthopaedic surgeon. He is a member of the Pediatric Orthopaedic Society of North America, the American Academy of Orthopaedic Surgeons and the American Academy of Pediatrics (AAP). He is a member of the Section on Orthopaedics of the AAP (and past member of the executive committee of this section), as well as the Sports Section. Dr. Esposito is a reviewer for PEDIATRICS, Journal of Pediatric Orthopaedics and CORR. He served as president of the medical staff (2008-2010). He is a member of the medical advisory board of the Osteogenesis Imperfecta Foundation. He has published and presented on osteogenesis imperfecta (OI) and made numerous presentations in the last two years regarding the treatment of OI. Dr. Esposito was once again selected as one of Best Doctors in America, an honor he has received since 1998.

Refereed Articles:

Grossman, L., Price, A., Rush, E., Goodwin, J., **Wallace, M., Esposito, P.** (2016). Initial Experience With Percutaneous IM Rodding of the Humeri in Children With Osteo-genesis Imperfecta. *Journal of Pediatric Orthopaedics.*

Azzam, K., Rush, E., Burke, B., Nabower, A., **Esposito, P.** (2016). Mid-term Results of Femoral and Tibial Osteotomies and Fassier-Duval Nailing in Children With Osteogenesis Imperfecta. *Journal of Pediatric Orthopaedics.*

Goeller, J., **Esposito, P.**, Wallace, M., Burke, B., Bailey, C. (2017). Perioperative Management of Pediatric Patients with Osteogenesis Imperfecta Undergoing Orthopedic Procedures. *Current Anesthesiology Reports.* Spring US. Vol 7 (2): p 142-149. 2167-6275

Book Chapter and Reviews:

Hasley, B.; **Esposito, P.** (2018) Osteogenesis Imperfecta. Elsevier. Spinal Fractures, Spondylolysis and Spondylolisthesis.

Honors, Awards and Offices Held:

- Barbara & Ronald W. Schaefer Endowed Chair, Pediatric Orthopaedic Surgery, University of Nebraska Medical Center, Omaha, NE, 2015-2020
- Honorary Co-Chair, Dinner Auction Benefiting Madonna School and Community-Based Services. August 25, 2018. Omaha, NE
- Volunteer Subspecialist, Clinic held during SOFT (Support Organization for Trisomy 18, 13 and Related Disorders Conference, July 20th, 2018 Omaha, NE
- Elected International Ambassador of the Bone and Joint Decade (BJD), Oct. 2014-Nov. 2017
- Medical Advisory Council, Osteogenesis Imperfecta Foundation, July 2011-present
- Medical Staff Committees, Children's Hospital & Medical Center:
  - Clinical Service Chief, Orthopaedic Surgery, 2009-present
  - Allied Health Committee, 2008-present
  - Credentials Committee, 2008-present
  - Quality and Patient Safety Committee, 2008-present
  - Focused Peer Review Committee, 2004-present
  - Surgical Services Performance Improvement & Safety (PIPS)
  - The Surgical Chiefs Committee (SSC)
- Consultant Reviewer:
  - *Journal of Pediatric Orthopaedics, BMJ Case Reports*, 2015-present
  - *Clinical Orthopaedics and Related Research* (CORR) 2010-present
  - *Pediatrics, American Academy of Pediatrics*, 2005-present

HANI HAIDER, PH.D.

Professor, Director of the Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory

Hani Haider, Ph.D., is a Professor and Director of the Orthopaedics Biomechanics & Advanced Surgical Technologies Laboratory, at the Department of Orthopaedic Surgery of the University of Nebraska Medical Center.

Professor Haider trained in England for a degree and PhD in Mechanical Engineering. From a fluid dynamics and mechatronics faculty teaching background at the University of Sheffield, he joined the faculty of University College London Medical School at the Centre of Biomedical Engineering in Stanmore in 1997. He produced the Instron-Stanmore Knee Simulator with its related ISO standard test method for simulation and wear testing of knee replacement systems. He was invited to join the faculty of the University of Nebraska Medical Center in March 2000.

In Nebraska, Dr. Haider has led over 90 research grants/contracts, totaling over $11 million, from 32 different orthopaedic companies from the USA, Europe and Japan. He has also had five invention patents issued, and has presented more than 300 scientific papers in journals and international conferences. He is Chair of the USA Technical Advisory Group and Head of the US delegation to the ISO TC 150 Committee (Implants for Surgery), member of the ASTM Executive Committee and Chair of its Division II Sub-Committee (Orthopaedic Devices), Director of Scientific Review for the International Society for Technology in Arthroplasty, and Reviews/Associate Editor for the Journal of Engineering in Medicine.

Dr. Haider has been awarded 16 different international and academic prizes in orthopaedics research and engineering. Three were university academic prizes during his student career, two as faculty from the University of Nebraska Medical Center for Special and Outstanding Professional Achievement, and one nationally for his accomplishments in Engineering. Internationally, he has received "The KLINGER International Research Prize"/Austria, and the HAP Paul Award by the International Society for Technology in Arthroplasty (ISTA) for innovation in joint replacement technology, and "Honorary Lifetime Membership" for outstanding contributions to technology in arthroplasty and to ISTA. Dr. Haider has also received four separate prizes from ASTM International, the Robert Fairer Award, the Manny Horowitz Award, the Leroy Wyman Award and lately, the Award of Merit and the honorary title of "Fellow" of ASTM International, its highest award "For outstanding leadership and high productivity in fostering the development and promulgation of surgical implant standards." Dr. Haider was the first recipient of the International Standards Organization (ISO) Committee Chairman's Award for his personal contributions to International Standards Development on Implants for Surgery. He was awarded the 2018 AAOS Best Poster Prize in the Adult Knee Category, and won the "Biomechanics Award" for the best full paper in the International Society for Technology in Arthroplasty at its 2018 Annual congress in London.

Current Research Grants:

Haider, H: Arthrex / FL - Modular Interlock Evaluation of a Unicompartmental Knee Replacement, Oct. 2016 – Jan. 2017.

Haider, H: Arthrex / FL - In-Vitro Study on the Initial Fixation and Micromotion of an Uncemented TKR Baseplate, March 2017 – Dec. 2017.

Haider, H: UNMC : AngioTeacher Interactive Educational Software, UNMC Cardiology. May 23, 2014 – ongoing, Haider (CI), O'Leary (CI).

Haider, H: Arthrex / FL - Pin-on-Disk UHMWPE Wear Comparison Between Titanium vs Cobalt- Chrome Orthopaedic Metal Alloys, April 2017– Dec. 2017.

Haider, H: Optimotion / FL, Constraint and Range of Motion Tests of the Optimotion CR TKA, Oct. 2017 – Dec. 2017.

Haider, H: Optimotion / FL, Further Constraint Testing of Modified Designs of the Optimotion Total Knee Replacement Systems, Jan. 2018 – March 2018.

Haider, H: Exponent / PA & Lima / Italy: Wear study of conventional and highly crosslinked vitamin E stabilized UHMWPE against polished and intentionally scratched CoCr metal femoral hip components, Feb 2018 – June 2018.

Duan Bin, Co-PI, Philippe Streubel, Co-PI, **Haider (Co-I)**, "3D Bioprinting of Biomimetic Constructs for Rotator Cuff Augmentation", NIH Grant # R01-AR073225-01, June 2018 – May 2023.

Haider, H: Optimotion / FL, An In Vitro Wear Durability Study of Two Sizes of OptiMotion Total Knee Replacement Systems, June 2018 – Dec. 2018.

Haider, H: Optimotion / FL, Knee Simulator Wear Study of a Middle Size Posterior Stabilized Optimotion Total Knee Replacement Systems, August 2018 – Dec. 2018.

Haider, H: TDA Research / CA, Pin-on-disk Wear Testing of Novel carbon fiber re-enforced UHMWPE for use as Bearing for the Total Joint, Sep. 2018 – Oct. 2018.

Haider, H: Optimotion / FL, Studying Uncemented Tibial Tray Micromotion, Bearing Interlock Strength and Constraint of the Optimotion Total Knee Replacement System, Nov. 2018 – April 2019.

Haider, H: Arthrex / FL, Battery of Three Types of Mechanical Tests of a new PS Total Knee Replacement System, Dec. 2018 – June 2019.

Haider, H: Arthrex / FL, Two Simulator Wear Tests of a New PS Total Knee Replacement System under Normal and Highly Abrasive Conditions, Dec. 2018 – June 2019.

Refereed Articles:

Urish, K. L., DeMuth, P. W., Kwan, B. W., Craft, D. W., Ma, D., **Haider, H.**, Tuan, R. S., Wood, T. K., & Davis III, C. M. : (2016). "Antibiotic-tolerant Staphylococcus aureus Biofilm Persists on Arthroplasty Materials." Clinical Orthopaedics and Related Research, 2016.

Haider, H., Weisenburger, J., Garvin, K.: (2018). "Simultaneous measurement of friction and wear in hip simulators.", Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine, 230(5), 373-388.

Haider, H., Weisenburger, J.N., Namavar, F., Garvin, K.: (2017). "Why Coating Technologies for Hip Replacement Systems, and the Importance of Testing Them In Vitro", Journal of Operative Techniques in Orthopaedics, ISSN 1048-6666

Chen Y., Li, Y., Koizumi, Y., **Haider, H.**, Chiba, H.: (2017). "Effects of carbon addition on wear mechanisms of CoCrMo metal-on-metal hip joint bearings", J. Materials Science and Engineering, C, 76 997–1004.

Book Chapter and Reviews:

Haider, H. and Baykal, D., (2016) "Wear Assessment of UHMWPE with Pin-on-Disc Testing," Chapter 30 on: Steven M kurtz, PhD., Editor, "UHMWPE Biomaterials Handbook – Ultra High Molecular Weight Polyethylene in Total Joint Replacement and medical Devices", Third Edition, pp. 553-578, Elsevier Inc.

Haider, H., (2016) Tribological Assessment of UHMWPE in the Knee", Chapter 23 in: Steven M. Kurtz, PhD., Editor, "UHMWPE Biomaterials Handbook – Ultra-High Molecular Weight Polyethylebe in Total Joint Replacement and medical Devices"' Third Edition, pp. 559-634, Elsevier Inc.

Barrera, O.A., and **Haider, H.**: (2016). "Direct Navigation of Surgical Instrumentation", Chapter 9 in; Ritacco, Lucas E., Milano, Federico E., Chai, Edmund (Eds), "Computer-Assisted Musculoskeletal Surgery – Thinking and Executing in 3D", Pub.: Springer, ISBN 978-3-319-12943-3

Haider, H. (2017), "Wear: Knee Joint Arthroplasty", Chapter 7.10, In: Ducheyne, P., Grainger, D.W., Healy, K.E., Hutmacher, D.W., and Kirkpatrick, C.J. (eds.), Comprehensive Biomaterials II, vol. 7, pp. 152–174. Oxford: Elsevier.

Honors, Awards and Offices Held:

- Biomechanics Award, by the International Society for Technology in Arthroplasty (ISTA) 2018 for best paper. "Challenging the Doctrine That Larger Contact Area Reduces Wear of Total Knee Replacements?"
- Received the AAOS 2018 Best Poster Prize in the Adult Knee Category, where award papers were chosen (one in each of ten categories) from over 7,000 papers submitted.

Haider continued

- Granted the "Award of Merit" and the honorary title of "Fellow" of ASTM International; its highest awards for "For outstanding leadership and high productivity in fostering the develop ment and promulgation of surgical implant standards, 2017
- Elected Chair of the United States Technical Advisory Group (TAG) for the International Organization for Standardization (ISO) on Implants for Surgery. Chair of the American National Standards Institute (ANSI) and ASTM International TAG for ISO/TC 150, and Chair of ASTM F04.93 committee. (Nov. 2018 – present)
- First Vice President – International Society for Technology in Arthroplasty (ISTA) (Oct 2018 – present)
- Reviews Editor, Journal of Engineering in Medicine, IMechE Part H. (March 2012 till present)
- NIH Grants Review Panel Member, Bioengineering, Technology, and Surgical Sciences (BTSS) Study Section, Center for Scientific Review, National Institutes of Health, (June 2018 – present)
- United States Patent # US 10219811 B2, "On-board tool tracking system and methods of computer assisted surgery". Priority date: 17 April 2014, Granted: 5 March 2019.
  - Inventor: Hani Haider, Ibrahim Al-Shawi, Osvaldo Andres Barrera.
- Director, Scientific Review and Information Technology, International Society for Technology in Arthroplasty (ISTA) (September 2011-present)
- Chair: Division II Committee (Orthop-aedic Devices) of ASTM International, (F04.02) (May 2018 – present)
- United States Patent # US 10080617 B2, "On-board Tool Tracking System and Methods of Computer Assisted Surgery". Priority date: 27 June 2011. Granted: 25 Sept. 2018.
  - Inventor: Hani Haider, Ibrahim Al-Shawi, Osvaldo Andres Barrera.
- Head of the US Delegation for the ISO annual meeting in Sydney, Australia 2016, and Nagoya, Japan 2017, and San Diego USA 2018.
- Chair the local Organizing Committee for the International Organization for Standardization (ISO) on Implants for Surgery 2018 annual Meeting in San Diego, CA.
- United States Patent # US 10105149 B2, "On-board tool tracking system and methods of computer assisted surgery". Priority date: 15 March 2013, Granted: 23 Oct. 2018.
  - Inventor: Hani Haider, Ibrahim Al-Shawi, Osvaldo Andres Barrera, David Scott Saunders.
- Deputy Chair – United States Technical Advisory Group (TAG) for the International Standards Organization (ISO) Technical Committee (TC) 150 on Medical Devices. (2017 – Nov. 2018).
- Coordinator/Liaison Officer, Working Group 2 (Implant Wear), ISO TC150 US Tag, 2013-present
- Member of the United States Delegation to the ISO Committee ISO/TC 150 (Medical Devices), 2002-present
- Deputy Chair of ASTM International F04.93 US TAG ISO/TC 150 Committee - Implants for Surgery (2017-Nov 2018)
- Technical (Expert) – Lead Contact, Friction of Hips Standard Writing Committee, Working Group/Item WK 28778 (2011-present)
- Co-Chair, Knee Wear Testing Standards Committee, 2002-present
- United States Patent #US 9498231 B2, "On-board tool tracking system and methods of computer assisted surgery", Priority date: 27 June 2011. Granted: 22 Nov. 2016.
  - Inventor: Hani Haider, Ibrahim Al-Shawi, Osvaldo Andres Barrera.
- Member of the Board of Directors, International Society of Technology in Arthroplasty (ISTA), 2005-present
- Editorial Board Member, Journal of Engineering in Medicine, IMechE Part H, 2009-present
- Associate Editor, Journal Advances in Orthopedics (June 2010-2018)
- Reviewer, Journal of Engineering in Medicine, IMechE Part H, 2007-present
- Member and Reviewer, Orthopaedic Research Society, (August 2009-present)
- Reviewer, Clinical Orthopaedics and Related Research (July 2010-present)
- Reviewer, Journal of Orthopaedic Research (2007-present)
- "Commercialization of Orthopaedic Surgical System" Award Recipient, UNeMed, 2016.

CURTIS W. HARTMAN, M.D.

Adult Reconstructive Surgery

Curtis W. Hartman, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation. He received his medical degree at the University of Missouri in 2003, and completed his orthopaedic surgery residency at the University of Nebraska/Creighton University Medical Center Health Foundation in 2008. Following residency, Dr. Hartman completed a fellowship in adult reconstruction at the Rush University Medical Center and Central DuPage Hospital, in Chicago, Illinois, in 2009. He is board certified in orthopaedic surgery. He is a member of the American Academy of Orthopaedic Surgeons (Member, Adult Reconstruction Hip Program Committee, 2016-present), the Mid-America Orthopaedic Association, the American Association of Hip and Knee Surgeons, the American Orthopaedic Association's Emerging Leaders Program, the Nebraska Medical Society, the Nebraska Orthopaedic Society and the Metro Omaha Medical Society.

Current Research Grants:

Hartman, C. The Utility of Oral Antibiotic Therapy Following 2-Stage Revision Arthroplasty for Infected Prosthetic Hips and Knees, Rush University. September 2013-completion. Hartman, C (PI).

Kielian, T. **Hartman, C.** Garvin, K. A Study of the Effect of Surgeries on Human Immune Status. Pfizer, Inc. 2014 – 2018

Refereed Articles:

Heim, C., Vidlak, D., Odvody, J., **Hartman, C.**, Garvin, K., Kielian, T: (2018). Human Prosthetic Joint Infections are Associated with Myeloid-derived Suppressor Cells (MDSCS's): Implications for Infection Persistence. *Journal of Orthopaedic Research*; 36(6), pp 1605-1613.

Book Chapter and Reviews:

Garvin, K., **Hartman, C.** (2017). Primary THA: Preoperative Planning and Templating. *Advanced Reconstruction Hip* 2, Eds: Jay R. Lieberman and Daniel J. Berry. Chicago, IL, The American Academy of Orthopaedic Surgeons, Chapter 7, pp 73-78.

Honors, Awards and Offices Held:

- Member, Adult Reconstruction Hip Program Committee, AAOS, 2016-present
- Board of Directors, Metro Omaha Medical Society Foundation, January 2015-present
- UNMC:
  - Faculty Senate, July 2016-present
  - Dissertation Committee, Kelsey Yamada, Ph.D. Student, Department of Pathology/Microbiology, 2016-present
  - UNMC Graduate Faculty, May 2013-present
  - Dissertation Committee, Raheleh Miralami, Ph.D. Student, MSIA Program, UNMC College of Medicine,2012-present
  - M3 Course Instructor September 2009-present
- Nebraska Orthopaedic Hospital:
  - Utilization Review Committee, 2013-present
  - Finance Committee, 2012-present

BRIAN P. HASLEY, M.D.

Pediatric Orthopaedic and Spine Surgery

Brian P. Hasley, M.D., is an associate professor of Orthopaedic Surgery at the University of Nebraska College of Medicine, Department of Orthopaedic Surgery and Rehabilitation. He earned his medical degree from the University of Nebraska College of Medicine in 1999 and completed his residency in orthopaedic surgery at the University of Nebraska Medical Center in 2004. Following residency, Dr. Hasley completed the Dorothy and Bryant Edwards Fellowship in pediatric orthopaedic surgery and scoliosis at the Texas Scottish Rite Hospital for Children, University of Texas at Southwestern Medical Center in Dallas (2005). Dr. Hasley completed post fellowship spine research at the same facility. Dr. Hasley is board certified in orthopaedic surgery. He is a fellow of the American Academy of Orthopaedic Surgeons, and a member of the Scoliosis Research Society the Pediatric Orthopaedic Society of North America (POSNA) and the Nebraska Orthopaedic Society. Dr. Hasley has been selected as one of the Best Doctors in America from 2007-2014.

Book Chapter and Reviews:

Hasley, B.; Esposito, P. Osteogenesis Imperfecta. (2018). Elsevier. Spinal Fractures, Spondylolysis and Spondylolisthesis.

Honors, Awards and Offices Held:

- Medical Staff Committees, Children's Hospital & Medical Center:
  - Surgical Services Performance Improvement & Safety (PIPS), 2018-present
  - Focused Peer Review Committee, 2008-present
- Health Policy Committee, Scoliosis Research Society, 2017-present

FACULTY **ACTIVITIES**

BEAU S. KONIGSBERG, M.D.

Adult Reconstructive Surgery

Beau S. Konigsberg, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Konigsberg received his medical degree from the University of Nebraska Medical Center in 2001, and completed his orthopaedic surgery residency at the University of Nebraska/Creighton University Health Foundation in 2007. Following residency, Dr. Konigsberg completed an adult reconstruction and arthroplasty fellowship at Midwest Orthopaedics at Rush/Rush University Medical Center in Chicago, Illinois (2008). He is board certified in orthopaedic surgery. He is a member of the Orthopaedic Research and Education Foundation, the American Academy of Orthopaedic Surgeons (member, Adult Reconstruction Hip Program, 2015-present), the Mid-America Orthopaedic Association, the American Association of Hip and Knee Surgeons, the American Orthopaedic Association Emerging Leaders Program, the Nebraska Orthopaedic Society, the Nebraska Medical Association and the Metro Omaha Medical Society.

Honors, Awards and Offices Held:

- Member, Adult Reconstruction Hip Program Committee, AAOS. June 2015-present
- UNMC:
  - Assistant Dean of Admission, UNMC College of Medicine, July 2018-present
  - Faculty Senate, January 2014-2018
  - Graduate Medical Faculty, 2013-present
  - Admissions Committee, College of Medicine, May 2011–present
  - Course Director, UNMC Orthopaedic Surgery Grand Rounds, October 2010-2018
  - Instructor, 2nd Year Medical Students, August 2009-present
- Nebraska Medicine
  - Service Chief, Orthopaedic Service Line, January 2019-present
  - Medical Director, 4th floor Lied Tower, January 2019-present
  - Member, Nebraska Medical Center Mortality Review Committee, January 2019-present
  - Perioperative Surgical Home Core Team, January 2019-present
  - Nebraska Medical Center Medical Staff Executive Committee, January 2019-present
  - Medical Director, Lauritzen Outpatient Center, Oakview Medical Building, and Bellevue Medical Center Orthopaedic Clinics, August 2016-preset
  - Ambulatory Rooming Project, November 2015-present
  - Perioperative Quality, Safety & Patient Experience Committee, September 2015-present
- Section Chief, Orthopaedics, Nebraska-Western Iowa VA Medical Center, January 2009-present
- Consultant Reviewer:
  - *Journal of Arthroplasty*, 2017-present
  - *Techniques in Orthopaedics*, June 2015-present
  - *Orthopaedics*, September 2013–present
  - *Journal of the American Geriatrics Society*, September 2010-present

SEAN V. MCGARRY, M.D.

Musculoskeletal Oncology

Sean V. McGarry, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. McGarry received his medical degree from the Creighton University School of Medicine in 1998. He completed a surgery internship at the University of Colorado Health Sciences Center in 1999 and continued on to complete his orthopaedic residency in 2004. Following residency, he completed an orthopaedic oncology fellowship at the University of Florida – Shands Hospital in 2005, where he researched the role of stem cells in bone and soft tissue cancer. Dr. McGarry was named the James R. Neff, M.D., Musculoskeletal Oncology Chair, UNMC Department of Orthopaedic Surgery and Rehabilitation in April 2017. Dr. McGarry is board certified in orthopaedic surgery and is a member of the American Academy of Orthopaedic Surgeons, the Musculoskeletal Transplant Foundation, the Musculoskeletal Tumor Society, the National Comprehensive Cancer Network, the Mid-America Orthopaedic Society, the Nebraska Orthopaedic Society and the Metro Omaha Medical Society.

Refereed Articles:

Cox, J., Cushman-Vokoun, A., **McGarry, S.**, Kozel, J. (2017). Two Cases of Mazabraud Syndrome and Identification of a Gnas R201 Mutation by Next-Generation Sequencing. *Virchows Archiv*, 470(5):589-593.

Zajicek, A., Bridge, J., Akers, J., **McGarry, S.**, Walker, C. (2017). Dedifferentiated Liposarcoma of the Lower Extremity with Low-Grade Dedifferentiation and Low-Grade Osteosarcomatous Component. *Skeletal Radiology*, 46(2):265-71.

Biermann, J., Chow, W., Reed, D., Lucas, D., Adkins, D., Agulnik, M., Benjamin, R., Brigman, B., Budd, G., Curry, W., Didwania, A., Fabbri, N., Hornicek, F., Kuechle, J., Lindskog, D., Mayerson, J., **McGarry, S.**, et. al. (2017). NCCN Guidelines Insights: Bone Cancer, Version 2.2017. *J Natl Compr Canc Netw*, 15(2), 155-167.

Zajicek, A., Bridge, J., Akers, J., **McGarry, S.**, Walker, C. (2016). Dedifferentiated liposarcoma of the lower extremity with low-grade dedifferentiation and low-grade osteosarcomatous component. *Skeletal Radiology*, 1-7.

Honors, Awards and Offices Held:

- James R. Neff, M.D., Musculoskeletal Oncology Chair, UNMC Department of Orthopaedic Surgery and Rehabilitation, April 2017 – present
- UNMC:
  - Faculty Senate, June 2013-present
  - Continuing Education Committee, October 2012-present
  - Tissue Bank Review Committee, Member, 2006-present
- Musculoskeletal Transplant Foundation (MTF):
  - Executive Committee, January 2015-present
  - Membership/Nominations Committee Member, February 2012 – present
  - Medical Board of Trustees, April 2006-present
- Member, Children's Hospital of Omaha Bylaws Committee, January 2008-present
- National Comprehensive Cancer Network (NCCN):
  - Soft Tissue Sarcoma Panel, July 2007-present
  - Bone Cancer Panel, May 2006-present
- Consultant Reviewer:
  - *Clinical Orthopaedics and Related Research*, March 2011-present
  - *Orthopaedics*, February 2011-present

JOSEPH A. MORGAN, M.D.

Hand, Upper Extremity and Microvascular Surgery

Joseph A. Morgan, M.D. is an assistant professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Morgan received his medical degree from the Indiana University School of Medicine in 2010, followed by a year-long sports medicine research fellowship at the Mayo Clinic Department of Orthopaedic Surgery in Rochester, Minnesota. He then completed an orthopaedic surgery residency at the University of Missouri Hospital and Clinics in Columbia, Missouri, in 2015, followed by a hand surgery fellowship at Chicago's Rush University Medical Center in 2016. Dr. Morgan is a member of the Nebraska Orthopaedic Society and a candidate member of the American Academy of Orthopaedic Surgeons and the American Society for Surgery of the Hand.

Book Chapter and Reviews:

Peterson, B., **Morgan, J.**, Bal, S. (2016). *The Direct Anterior Approach to Hip Reconstruction.* Chapter 12, Transitioning to Direct Anterior Total Hip Replacement; Thorofare, NJ: SLACK Incorporated; 149-159

Honors, Awards and Offices Held:

- Member, ACGME Residency Milestones Committee, UNMC

MATTHEW A. MORMINO, M.D.

Orthopaedic Traumatology and Lower Extremity

Matthew A. Mormino, M.D., is professor and residency program director, as well as the Herman Frank Johnson, M.D., Professor of Orthopaedic Surgery and Rehabilitation in the Department of Orthopaedic Surgery and Rehabilitation. He received his medical degree from the University of Illinois College of Medicine (1991) and completed his orthopaedic surgery residency at Creighton University/University of Nebraska Medical Center Health Foundation (1996). He also completed a trauma fellowship at the University of Washington in 1997. A board-certified orthopaedic surgeon, Dr. Mormino is a diplomate of the American Board of Orthopaedic Surgery. He is a member of the American Academy of Orthopaedic Surgeons, the Orthopaedic Trauma Association and the Mid-America Orthopaedic Association. He serves as a consultant reviewer of the Journal of the American Academy of Orthopaedic Surgeons. Dr. Mormino has been selected as one of the Best Doctors in America from 2005-2018, and as one of Castle Connolly's Regional Top Doctors from 2012-2018.

Refereed Articles:

Bonness, E., Siebler, J., Reed, L., Lyden, E., **Mormino, M.** (2018). An Immediate Weight-bearning Protocol for the Determination of Ankle Stability In Patients with Isolated Distal Fibular Fractures. *Journal of Orthopaedic Trauma*.

Osborn, P., Ames, S., Turner, N., Caird, M., Karam, M., **Mormino, M.**, Krueger, C. (2018). An Analysis of Research Quality and Productivity at Six Academic Orthopaedic Residencies. *Journal of Surgical Education*.

Nielsen, P; Grossman, L; Siebler, J; Lyden, E; Reed, L; **Mormino, M.** (2018). Is It Safe to Prep the External Fixator In Situ During Second-Stage Pilon Surgical Treatment?. *Journal of Orthopaedic Trauma*. Vol. 32 (3): p. e102-e105

Mellema, J., Mallee, W., Guitton, T., van Dijk, C., Ring, D., Doornberg, J., Science of Variation Group & Traumaplatform Study Collaborative (**Mormino, M**). (2017). Online Studies on Variation in Orthopedic Surgery: Computed Tomography in MPEG4 Versus DICOM Format. *Journal of Digital Imaging*, 1-8.

Mellema, J., Doornberg, J., Molenaars, R., Ring, D., Kloen, P., Traumaplatform Study Collaborative & Science of Variation Group (**Mormino, M.**), (2016). Interobserver reliability of the Schatzker and Luo classification systems for tibial plateau fractures. *Injury, Int. J. Care Injured*, 47(4), 944-949.

Claessen, F., Stoop, N., Doornberg, J., Guitton, T., van den Bekerom, M., Ring, D., Science of Variation Group (**Mormino, M.**), (2016). Interpretation of Post-operative Distal Humerus Radiographs After Internal Fixation: Prediction of Later Loss of Fixation. *The Journal of Hand Surgery*, 41(10), e337-e341.

Neary, K., **Mormino, M.**, Wang, H. (2016). Suture Button Fixation Versus Syndesmotic Screws in Supination-External Rotation Type 4 Injuries: A Cost-Effectiveness Analysis. *Am J Sports Med.*

Book Chapter and Reviews:

Mormino, M., Siebler, J: (2018). *Harborview Illustrated Tips and Tricks in Fracture Surgery. Second. LWW*; Chapter 8, Distal Humeral Fracture Fixation with an Extensor Mechanism-On Approach; 744

Honors, Awards and Offices Held:

- Best Doctors in America, 2018
- Castle Connolly Regional Top Doctors, 2018
- UNMC Department of Orthopaedic Surgery, Residency Program Director, 2004-present
- Mid-America Orthopaedic Association:
  - First Vice President, 2018-2019
  - Audit Committee, 2018-2019
  - Planning Committee, 2018-2019
  - Second Vice President, 2017-2018
- AO North America:
  - Fellowship Advisory Board, 2011-present
  - Faculty, 1997-present
- Nebraska Medicine:
  - Medical Director Perioperative Services, 2008- present
  - Graduate Medical Education Committee
- Consultant Reviewer:
  - Journal of Orthopaedic Trauma, February 2014-present
  - Journal of Surgical Education, 2010-present
  - Journal of the American Academy of Orthopaedic Surgeons, 1999-present

FACULTY **ACTIVITIES**

SUSAN A. SCHERL, M.D.

Pediatric Orthopaedic Surgery

Susan A. Scherl, M.D., is a professor in the Department of Orthopaedic Surgery and Rehabilitation. She earned her medical degree from the Boston University School of Medicine in 1987. Dr. Scherl completed two years of a general surgery residency at St. Luke's/Roosevelt Hospital Center in New York (1989) and a five-year orthopaedic residency at State University of New York Health Science Center in Brooklyn (1994). She completed a pediatric orthopaedic fellowship at Case Western Reserve University in Cleveland in 1995. She is board certified in orthopaedic surgery and is a member of the Pediatric Orthopaedic Society of North America (POSNA), the American Orthopaedic Association, the American Academy of Orthopaedic Surgeons, the American Academy of Pediatrics and the Orthopaedic Trauma Association. In addition, she is one of only two orthopaedic members of the Helfer Society, the professional organization of child abuse physicians. Dr. Scherl was selected as one of the Best Doctors in America for 2003-2005, and 2007-2018. She has edited two textbooks on musculoskeletal medicine, authored numerous book chapters and article reviews and regularly presents at conferences and institutions across the country.

Refereed Articles:

Scherl, S.: Registry for Orthopaedic Trauma in Children (ROTC); Funding Agency: Carolinas Healthcare System; 2015 - 2020

Refereed Articles:

Scherl S., (2017). Re: Imaging and reporting considerations for suspected physical abuse (non-accidental injury) in infants and young children. Part 1: Initial considerations and appendicular skeleton. *Clinical Radiology*, 72 : 421. 2017

Book Chapter and Reviews:

Scherl, S. (2017). *Orthopedic Surgery Clerkship: A Quick Reference Guide for Senior Medical Students*. 1st. Providence, RI: Springer. Chapter 117, Child Abuse; 557-564

Honors, Awards and Offices Held:

- Volunteer for Perry Outreach Program, a daylong program to introduce high school age girls to the possibility of a career in orthopaedics, Omaha, NE, Nov. 12, 2016; Nov. 18, 2017; Nov. 17, 2018
- American Academy of Orthopaedic Surgeons Annual Meeting Program Committee, Allied Health Representative, June 2016-present
  - Section on Orthopaedics Executive Committee, September 2017-present
  - Liaison from the Section on Orthopaedics to the Committee on Child Abuse and Neglect, June 2016-present
- Children's Hospital & Medical Center:
  - Medical Education Committee, January 2011-present
  - Trauma Performance Improvement and Patient Safety Committee, 2009-present
- Liaison between the American Association of Orthopaedic Surgeons Pediatric Education Chair and the Pediatric Orthopaedic Society of North America Education Council, Ag. 2016-present
- Austrian Swiss German Traveling Fellowship Task Force Lead, American Orthopaedic Association, June 2018-present
- Scherl, SA: "Physeal Injuries in Children", 8th Annual Dr. Rex & Lillian Diveley Pediatric Orthopedic Visiting Professorship, Children's Mercy Hospital, Kansas City, MO, October 19, 2017
- Scherl, SA: "Top 10 Reasons Why Children's Fractures are Different from Adult Fractures", "Monteggia Fractures and Other Fractures of the Forearm", "Physeal Fractures Abouth the Knee". First International Pediatric Trauma Course, Kyiv, Ukraine, October 26-27, 2018
- Consultant Reviewer:
  - *Helfer Society Quarterly Review*, 2016-Present
  - *Journal of Pediatric Orthopaedics*, 2007-present
  - *Journal of Orthopaedic Trauma*, 2004-present
  - *Clinical Orthopaedics and Related Research*, 2004-present
  - *Pediatrics*, 2003-present

JUSTIN C. SIEBLER, M.D.

Orthopaedic Traumatology

Justin C. Siebler, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation and Chief of Orthopaedic Trauma. Dr. Siebler received his medical degree at the University Nebraska Medical Center in 2004 and completed his orthopaedic surgery residency at the Creighton University/University of Nebraska Health Foundation Orthopaedic Surgery Residency Program in 2009. He then completed an orthopaedic traumatology fellowship at the Florida Orthopaedic Institute in Tampa, Florida in 2010. Prior to joining the department, Dr. Siebler was an assistant professor of orthopaedic surgery at Creighton University (2010-2014). He is a board-certified orthopaedic surgeon, and a fellow of the American Academy of Orthopaedic Surgeons. He is a member of the Orthopaedic Trauma Association, and the Mid-America Orthopaedic Association.

Refereed Articles:

Bonness, E., **Siebler, J.**, Reed, L., Lyden, E., Mormino, M. (2018). An Immediate Weight-Bearing Protocol for the Determination of Ankle Stability In Patients with Isolated Distal Fibular Fractures. *Journal of Orthopaedic Trauma*. Vol. 32 (10): p. 534-537

Durye, M., Dusand, A., Hunter, C., Kharbanda, K., Bruenjes, J., Easterling, K., **Siebler, J.** (2018). Thiele, G; Chakkalakal, D. N-acetyl Cysteine (NAC) Treatment Restores Early Phase Fracture Healing in Ethanol-Fed Rats. *Alcoholism: Clinical and Experimental Research*. 0145-6008

Nielsen, P., Grossman, L., **Siebler, J.**, Lyden, E., Reed, L., Mormino, M. (2018) Is It Safe to Prep the External Fixator In Situ During Second-Stage Pilon Surgical Treatment? *Journal of Orthopaedic Trauma*. Vol. 32 (3): p. e102-e105

Sagi, H., Donohue, D., Cooper, S., Barei, D., **Siebler, J.**, Archdeacon, M., Sciadini, M., Romeo, M., Bergin, P., Higgins, T., Mir, H. (2017). Institutional and Seasonal Variations in the Incidence and Causative Organisms for Posttraumatic Infection following Open Fractures. *Journal of Orthopaedic Trauma*. Vol. 31 (2): p. 78-84.

Book Chapters:

Mormino, M., **Siebler, J.** (2018) *Harborview Illustrated Tips and Tricks in Fracture Surgery*. Second Ed. Philadelphia: Wolters Kluwer. Chapter 8, Distal Humeral Fracture Fixation with an Extensor Mechanism-On Approach; 159-176

Siebler, J., Larson D. (2017). Orthopedic Surgery Clerkship: A Quick Reference Guide for Senior Medical Students. Springer Nature. Chapter 146, Necrotizing Fasciitis; 711-713

Porter, N., **Siebler, J.** (2017). Orthopedic Surgery Clerkship: A Quick Reference Guide for Senior Medical Students. Springer Nature. Chapter 145, Osteomyelitis; 707-710

Bowman, E., **Siebler, J.** (2017). Orthopedic Surgery Clerkship: A Quick Reference Guide for Senior Medical Students. Springer Nature. Chapter 144, Septic Arthritis; 703-706

Awards and Offices Held:

- Orthopaedic Trauma Association Annual Meeting Highlight Award Paper, 2017. Vancouver, BC. "An Immediate Weight-Bearing Protocol for the Determination of Ankle Stability In Patients with Isolated Distal Fibular Fractures". **Siebler, J.**, Bonness, E., Reed, L., Mormino, M.
- Chairman, MAOA/ICJR Pre-Meeting Course; Orthopaedic Trauma: Current Concepts, Mid-America Orthopaedic Association, 2018-2019 (April 10, 2019)
- Program Committee, Mid-America Orthopaedic Association, 2017-present
- Trauma Program Committee, AAOS, 2015-present
- AO North America Orthopaedic Trauma Faculty, 2012-Present
- Nebraska Medicine:
  - Perioperative Surgical Services Operations Committee, 2015-present
  - Trauma Peer Review Committee, 2014-present
  - Trauma Performance Improvement/ Patient Safety Committee, 2014-present
- UNMC:
  - Director, Orthopaedic Career Specialty Track; Phase 3, 2018-present
  - COM Phase 3 Design Team, Member, 2018-Present
  - Graduate Medical Education Committee, 2017-Present
  - Continuing Medical Education Committee, 2015-present

PHILIPP N. STREUBEL, M.D.

Shoulder, Elbow and Hand Surgery

Philipp N. Streubel, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Streubel received his medical degree at Pontificia Universidad Javeriana in 2002 and completed his orthopaedic residency at the Universidad del Rosario in Bogotá in 2008. He then moved to the United States and completed three surgical fellowships: orthopaedic trauma at Vanderbilt Medical Center in Nashville, TN, in 2001; shoulder and elbow surgery at the Mayo Clinic in Rochester, MN, in 2012 and hand surgery at Rush University Medical Center in Chicago, IL, in 2014. Dr. Streubel has extensive research experience and served as a research coordinator at Fundacion Santa Fe de Bogota in Bogota, Colombia (2002-2004); research fellow at the Center of Investigation and Documentation, AO Foundation in Zurich, Switzerland (2007); and research fellow for the Orthopaedic Trauma Service at the Washington University School of Medicine in St. Louis, MO (2008 – 2010). He is a candidate member of the American Society for Surgery of the Hand and the American Academy of Orthopaedic Surgery, as well as a member of the Orthopaedic Trauma Association, the Colombian Society of Orthopedic Surgery and Traumatology, the AO Foundation Alumni Association, the Mid-America Orthopaedic Association, the Mayo Clinic Alumni Association and the Vanderbilt Orthopedic Society. Dr. Streubel is fluent in English, Spanish and German.

Current Research Grants:

Streubel, P., Duan, B., Haider, H. RO1 Grant, National Institute of Health.

Refereed Articles:

Obremskey, W., Molina, C., Richards, J., Staples, K., **Streubel, P.** (2018). Avilucea F. *Technique in Orthopaedics*. Wolters Kluwer Health, Inc; Early Surgical Treatment of Severe Multiligamentous Knee Injuries; 1-11

Collinge, C., Hymes, R., Archdeacon, M., **Streubel, P.**, Obremskey, W., Weber, T., Watson, J., Lowenberg, D. (2016). Unstable Proximal Femur Fractures Treated With Proximal Femoral Locking Plates: A Retrospective, Multicenter Study of 111 Cases. *Journal of Orthopaedic Trauma*, 30(9), 489-495.

Streubel, P., Simone, J., Morrey, B., Sanchez-Sotelo, J., Morrey, M. (2016). Infection in total elbow arthroplasty with stable components: outcomes of a staged surgical protocol with retention of the components. *Bone Joint J*, 98-B(7), 976-983.

Book Chapter and Reviews:

Streubel, P., Grossman, L. (2018). Heckman Ed. *Rockwood and Green's Fractures in Adults*. 9. Lippincott Williams and Wilkins; Forearm Shaft Fractures

Capo, J., Gottschalk, M., **Streubel, P.**, Rizzo, M. (2018). Heckman Ed. *Rockwood and Green's Fractures in Adults*. 9. Lippincott Williams and Wilkins; Hand Fractures

Honors, Awards and Offices Held:

- International Relations Committee, American Society for Surgery of the Hand, 2016-present
- UNMC
  - Faculty Grievance Committee, 2018 – Present
  - Orthopaedic Surgery Resident Research Committee, 2016-Present
  - Research and Development Committee, 2015-present
- AO North America
  - Trauma Faculty, 2014-present
  - Hand Faculty, 2014-present
- Consultant Reviewer
  - *Journal of Hand Surgery* (European Volume), 2017-Present
  - *Journal of Orthopaedic Research*, 2017-Present
  - *Journal of Orthopaedic Trauma*, 2012-present
  - *Journal of Shoulder and Elbow Surgery*, 2012-present

MATTHEW J. TEUSINK, M.D.

Shoulder and Elbow Surgery

Matthew J. Teusink, M.D., is an assistant professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Teusink received his medical degree from the University of Iowa Carver College of Medicine in Iowa City, IA, in 2007. He then completed his orthopaedic residency at the University of Iowa Hospitals and Clinics, also in Iowa City, in 2012. Following residency, Dr. Teusink completed a shoulder and elbow fellowship at the Florida Orthopaedic Institute in Tampa, FL, from 2012-2013. He is a reviewer for the Journal of Shoulder and Elbow Surgery and Orthopaedics. He is an active fellow member of the American Academy of Orthopaedic Surgery, as well as a member of the Mid-America Orthopedic Association, the Nebraska Orthopaedic Society and the American Orthopaedic Association's Emerging Leaders Program.

Current Research Grants:

Xie, J., **Teusink, M.** "Small Molecules Bound 3D Hybrid Nanofiber Aerogels for Healing Large Cranial Bone Defects." National Institutes of Health R21 Grant. 2018-2020. Xie, J. (PI), Teusink, M. (CI).

Siebler, J., **Teusink, M.** "Data Use Agreement: Regional and Seasonal Variations in the Incidence of Post-Traumatic Infection After Open Extremity Fractures." 2017-2019. Siebler, J (IRB), Teusink, M. (IRB).

Xie, J., **Teusink, M.** Combining Biomimetic 3D Nanofiber Scaffolds with AdiposeStem Cells for Rotator Cuff Injury Repair, Orthopaedic Research and Education Foundation. 2016-2019. Xie, J (PI), Teusink, M (CI).

Teusink, M. "Long Term Outcome Follow-up of Glenoid Anchor Peg Component Fixation Utilizing Autologous Bone Graft in Total Shoulder Arthroplasty" 2016 – completion.

Refereed Articles:

Lin. Boda, S., Wang, H., **Teusink, M.**, Shuler; Xie, J. (2018). Novel 3D Hybrid Nanofiber Aerogels Coupled with BMP-2 Peptides for Cranial Bone Regeneration. *Advanced Healthcare Materials*. Wiley

Weng, L., Boda, S., Wang, H., **Teusink, M.**, Shuler, F., Xie, J. (2018). Novel 3D Hybrid Nanofiber Aerogels Coupled with BMP-2 Peptides for Cranial Bone Regeneration. *Advanced Healthcare Materials*.

Chen, S., Ge, L., Mueller, A., Carlson, M.., **Teusink, M.**, Shuler, F., Xie, J. (2017). Twisting electrospun nanofiber fine strips into functional sutures for sustained co-delivery of gentamicin and silver. *Nanomedicine: Nanotechnology, Biology, and Medicine*. 13 : 1435-1445.

Weng, L., Boda, S., **Teusink, M.**, Shuler, F., Li, X., Xie, J. (2017). Binary Doping of Strontium and Copper Enhancing Osteogenesis and Angiogenesis of Bioactive Glass Nanofibers while Suppressing Osteoclast Activity. *ACS Applied Materials and Interfaces*. 9 : 24484-24496.

Chen, S., Ge, L., Mueller, A., Carlson, M., **Teusink, M.**, Shuler F., Xie J. (2017). AdiposeStem Cells Twisting electrospun nanofiber fine strips into functional sutures for sustained co-delivery of gentamicin and silver. *Nanomedicine: nanotechnology, biology, and medicine* (English), Vol. 13 (4): p. 1435-1445. 1549-9634

Jiang, J., Li, Z., Wang, H., Wang, Y., Carlson, M., **Teusink, M.**, MacEwan, M., Gu, L., Xie, J. (2016). Expanded 3D Nanofiber Scaffolds: Cell Penetration, Neovascularization, and Host Response. *Advanced Healthcare Materials*, 5(23), 2993-3003.

Book Chapter and Reviews:

Xie, J., Jiang, J., **Teusink, M.**, Shuler, F. (2016). *Nanocomposites for musculoskeletal tissue regeneration*. Woodhead (an imprint of Elsevier); Chapter 15, Hydroxyapatite Nanocomposites for Tendon Repair

Otto, R., **Teusink, M.** (2016). *Reverse Shoulder Arthroplasty: Clinical Techniques and Devices*. Springer. Chapter 18, Reverse Shoulder Arthroplasty in the Setting of Scapula Fractures

Xie, J., Jiang, J., **Teusink, M.**, Shuler, F.. (2016). *Hydroxyapatite Nanocomposites for Tendon Repair*. Elsevier Inc; Nanocomposites for Musculoskeletal Tissue Regeneration; 307-330

Honors, Awards and Offices Held:

- Emerging Leaders Program, American Orthopaedic Association, June 2015-present
- UNMC
  - Senator, UNMC Faculty Senate, 2018 - 2019
  - Committee Member, Fritch Surgery Center Orthopaedic Operations Committee, 2017-present
  - Director, M4 Curriculum Development, 2016-present
  - Chair, Residency Research Committee, 2016-present
  - Physicians Leadership Academy, 2015-present
  - Residency Selection Committee, 2014-present
- Consultant Reviewer:
  - *Journal of Shoulder and Elbow Surgery*, 2014-present
  - *Orthopaedics*, 2013-present

MAEGEN J. WALLACE, M.D.

Pediatric Orthopaedic Surgery

Maegen J. Wallace, M.D., is an assistant professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Wallace received her medical degree from the University of Nebraska Medical Center in 2008, followed by an orthopaedic surgery residency at St. Louis University in St. Louis, MO, in 2014. She then completed a one-year pediatric orthopaedic surgery fellowship at the DuPont Hospital for Children in Wilmington, DE. Dr. Wallace is a member of the American Academy of Orthopaedic Surgeons, a member of the American Orthopaedic Association's Emerging Leaders Program, a member of the Creighton Business Institute's Leadership Experience Accelerator Program and a candidate member of the Pediatric Orthopaedic Society of North America.

Refereed Articles:

Grossman, L., Price, A., Rush, E., Goodwin, J., **Wallace, M., Esposito, P.** (2016). Initial Experience With Percutaneous IM Rodding of the Humeri in Children With Osteogenesis Imperfecta. *Journal of Pediatric Orthopaedics*.

Atanda, A., Jr., Averill, L., **Wallace, M.**, Niiler, T., Nazarian, L., Ciccotti, M. (2016). Factors Related to Increased Ulnar Collateral Ligament Thickness on Stress Sonography of the Elbow in Asymptomatic Youth and Adolescent Baseball Pitchers. *American Journal Sports Medicine*, 44(12), 3179-3187.

Wallace, M., Kruse, R., Shah, S. (2017). The spine in patients with osteogenesis imperfecta. *Journal of the American Academy of Orthopaedic Surgeons*, 25(2), 100-109.

Honors, Awards and Offices Held:

- Member, Leadership Experience Accelerator Program (LEAP), Creighton Business Institute, September 2018-April 2019
- Volunteer for Perry Outreach Program, a daylong program to introduce high school age girls to the possibility of a career in orthopaedics, Omaha, NE, Nov. 12, 2016; Nov. 18, 2017; Nov. 17, 2018
- Volunteer Subspecialist, Clinic held during SOFT (Support Organization for Trisomy 18, 13 and Related Disorders) Conference, July 20th, 2018. Omaha, NE
- Board of Directors, Jansen's Foundation, February 2017-present
- Children's Hospital & Medical Center
  - Credentials Committee, January 2016-present
  - Children's Specialty Physicians Operating Compliance Committee, 2016-present
  - Medical/Surgical Interdisciplinary Committee, September 2015-present
- Pediatrics Content Committee, American Academy of Orthopaedic Surgeons, January 2018-present
- Residents Review Newsletter Publication Committee, Pediatric Orthopaedic Society of North America, 2015-present
- Member, Emerging Leaders Program, American Orthopaedic Association, 2013-present

OTHER FACULTY

Glen M. Ginsburg, M.D.

Glen Ginsburg, M.D., is a volunteer associate professor of Orthopaedic Surgery at the University of Nebraska Medical Center. He received his M.D. from the School of Medicine and Biological Sciences at the State University of New York at Buffalo, where he also completed a general surgery residency, as well as his orthopaedic residency training. Dr. Ginsburg completed a pediatric orthopaedic fellowship at the Children's Hospital Los Angeles at the University of Southern California Department of Orthopaedic Surgery. He is a board-certified orthopaedic surgeon. Dr. Ginsburg is the clinical director of the Motion Analysis Laboratory at UNMC's Munroe-Meyer Institute, and serves as an academic advisor to orthopaedic residents in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Ginsburg retired to volunteer associate professor status on March 15, 2011.

Walter W. Huurman, M.D.

Walter W. Huurman, M.D., is a professor emeritus of Orthopaedic Surgery and Pediatrics at the University of Nebraska Medical Center. He received his M.D. from Northwestern University and completed his orthopaedic residency at the U.S. Naval Medical Center in Oakland, California, and the University of California, San Francisco. He completed training in pediatric orthopaedic surgery at the A.I. duPont Institute. A board-certified orthopaedic surgeon, Dr. Huurman has served on the editorial boards of the American Academy of Pediatrics Journal, Pediatrics in Review, and the Journal of Pediatric Orthopaedics. He has served as associate editor of the Journal of Bone and Joint Surgery, and on the editorial review boards of the Journal of the American Academy of Orthopaedic Surgeons and Clinical Orthopaedics and Related Research. Dr. Huurman served as an oral examiner for the American Board of Orthopaedic Surgery (1982, 1986-87, 1990-92, and 1994-2003). He is a member of the Pediatric Orthopaedic Society of North America, the American Academy of Orthopaedic Surgeons, the American Academy of Pediatrics, the North American Spine Society and the American Orthopaedic Association. His areas of concentration include the juvenile spine, clubfoot, and juvenile hip disease, as well as editing pediatric publications. Dr. Huurman retired to professor emeritus status on July 31, 2006.

Kody Moffatt, M.D.

Dr. Moffatt is the director of Pediatric Sports Medicine at Children's Hospital and Medical Center in Omaha, Nebraska and is an adjunct associate professor in the Department of Orthopaedic Surgery & Rehabilitation and the Department of Pediatrics at the University of Nebraska Medical Center. He is also an associate professor of Pediatrics at Creighton University School of Medicine. Dr. Moffatt received his M.S. in Orthopaedic Surgery and his M.D. from the University of Nebraska Medical Center. He completed his residency training in the Joint CU-UNMC Pediatric Residency Program and joined the university faculty in 2003. He is a Fellow of the American Academy of Pediatrics (AAP) and the American College of Sports Medicine, and is board certified in Pediatrics. Dr. Moffatt was elected to the AAP's Council on Sports Medicine and Fitness Executive Committee. He chairs the Sports Medicine Advisory Committee and serves as physician for state championships for the Nebraska School Activities Association. Dr. Moffatt has received several honors and awards, is a member of numerous professional organizations and has been published in peer-reviewed journals and textbooks. His main research interests are in pediatric sports medicine and vaccine medicine.

NEWS

GIVING BACK TO THE COMMUNITY

Department of Orthopaedic Surgery faculty, residents and staff dedicate much of their free time to helping advance UNMC's core values through community outreach and volunteer efforts in the Omaha community and beyond. Over the past two years, department members have had numerous opportunities to donate their time, skills and resources to organizations and people in need.

FDA learns from Biomechanics Lab



Ten implant reviewer experts from the FDA's Center for Devices and Radiological Health (CDRH) visited Omaha in December 2017 to study the orthopaedic implant testing techniques and innovative developments at the Biomechanics and Advanced Surgical Technologies Laboratory. The group included reviewers and supervisors for hip, knee, shoulder, ankle, joint replacement and spinal devices. During the two-day visit, Dr. Haider delivered a series of lectures and practical lab demonstrations on aspects of cutting-edge technology and procedures for implant wear testing. The FDA group also met with Orthopaedic Department adult reconstructive, shoulder and spine surgeons to exchange ideas on the clinical perspective of implant longevity and regulatory procedures for patient safety.

Department Chair hosts The Hip Society in Omaha



Kevin Garvin, M.D., professor and chair of the department, hosted the 50th Summer Meeting of The Hip Society Oct. 5-7, 2017 in Omaha. Dr. Garvin was elected president of the society for 2017-2018 and is the sole orthopaedic surgeon representing Nebraska in the society. More than 100 orthopaedic surgeons attended the members-only meeting, which also commemorated the society's 50th anniversary. Visiting members and their guests experienced a first-class tour of Omaha, including a visit to UNMC's Biomechanics and Advanced Surgical Technologies Laboratory, a reception at the Holland Performing Arts Center, a private rehearsal of the Omaha Symphony led by Maestro Thomas Wilkins and a behind-the-scenes tour of the Henry Doorly Zoo.

The Perry Initiative

In fall 2018, the Department of Orthopaedic Surgery hosted the fifth annual Perry Outreach Program, a signature event of The Perry Initiative. Since coming to UNMC, the event has drawn approximately 40 young women each year, with the most recent event bringing together students from 21 high schools throughout Nebraska. The program offers a chance for high school-aged women to learn more about pursuing a career in orthopaedics, as well as the opportunity to meet and learn from respected female orthopaedic surgeons and engineers. At the daylong outreach event, participants learned to suture using pigs' feet, performed a knee arthroscopy on replicas of human bones and gained hands-on experience in simple and complex fracture repair with plates and intramedullary nails. Faculty organizers and volunteers included Susan Scherl, M.D., Maegen Wallace, M.D., and Katie L. Freeman, M.D.



Department Chair named director-elect of the American Board of Orthopaedic Surgery



Kevin Garvin, M.D., professor and chair of the department, has been elected director-elect of the American Board of Orthopaedic Surgery. The board consists of 21 members, which includes 12 active directors, six senior directors, two directors-elect, and one public member director. Dr. Garvin will serve one 10-year term. Nominations come from the American Orthopaedic Association, the American Academy of Orthopaedic Surgeons, and the American Medical Association. The American Board of Orthopaedic Surgery, Inc. was founded in 1934 as a private, voluntary, nonprofit, independent organization to serve the best interests of the public and the medical profession. These interests are achieved through the American Board of Orthopaedic Surgery by establishing standards for the education of orthopaedic surgeons.

OTHER **NEWS**

Best Children's Hospital in Orthopedics

Our pediatric clinical partner, Children's Hospital & Medical Center, was recognized by U.S. News and World Report as a Best Children's Hospital in Orthopedics for 2018-2019, ranking No. 42 of 50 in orthopaedics. The ranking is based on various measures of clinical care, including quality, range of services available, volume, availability of subspecialists and other clinical support in a pediatric setting.

The Nebraska Medical Center Named Top Hospital in The State

Nebraska Medicine, UNMC's hospital partner, was named the Top Hospital in Nebraska for 2017-18 and 2018-19. U.S. News & World Report compared more than 4,500 medical centers across the country to come up with this year's list of Best Hospitals, of which fewer than 160 were nationally ranked. This is the seventh consecutive year the hospital has been designated No. 1 in the state.

Nebraska Medicine Again Named to 100 Great Hospitals List

For the fifth straight year, *Becker's Hospital Review* has named Nebraska Medicine to its prestigious list of "100 Great Hospitals in America," a compilation of some of the most prominent, forward-thinking and focused healthcare facilities in the nation. Hospitals included on the list are home to many medical and scientific breakthroughs, provide best-in-class patient care and are stalwarts of their communities, serving as research hubs or local anchors of wellness.

CORE

SCIENTIFIC ABSTRACTS

Innovative research being done at the University of Nebraska Medical Center Department of Orthopaedic Surgery and Rehabilitation is attracting an increasing amount of external and international funding and acclaim, with faculty presenting their results at prestigious national and international scientific and academic conferences.

Here is a highlight of the cutting-edge research that is defining tomorrow's treatment methods.

The Efficacy of Liposomal Bupivacaine in Lumbar Spine Surgery

Emmett J Gannon[1*], Chris A Cornett[1], Evan P Larson[1] and Elizabeth R Lyden[2]

[1]Department of Orthopaedic Surgery and Rehabilitation, University of Nebraska Medical Center, USA
[2]Department of Biostatistics, College of Public Health, University of Nebraska Medical Center, USA

BACKGROUND

Pain management is an important portion of a patient's postoperative care. Improved pain control can lead to improved outcomes, earlier mobilization, and shortened hospital stays. With the large side-effect profile of narcotics, numerous alternative methods to decrease opioid consumption, attain better pain-control and improve outcomes have been used. The emergence of the long-acting local anesthetic agent, Liposomal Bupivacaine (LB), has shown promise in improving pain control and decreasing opioid consumption.

STUDY DESIGN

This is a retrospective study.

OBJECTIVE

This study aims to determine the efficacy of LB in lumbar spine surgery.

METHODS

A total of 54 consecutive lumbar spine cases were performed in which LB was administered in all cases. This was then matched to a cohort of 54 patients who underwent lumbar procedures in the period immediately preceding the initial use of LB. Demographic data and hospital Length of Stay (LOS) were recorded. Pain scores were recorded using the Visual Analog Scale (VAS) and were recorded as an average over 8 hour shifts for 72 hours postoperatively. Daily narcotic consumption was also measured and converted to oral morphine equivalents.

RESULTS

There was a statistically significant difference in the mean LOS between the two groups (p=0.0071). The mean LOS for the LB group was 2.04 days and 2.73 days for the control group. A significant difference was also found between the two groups in VAS scores (p=0.016) and narcotic use (p=0.048). The LB group was found to have lower VAS scores and opioid consumption compared to the control group.

CONCLUSION

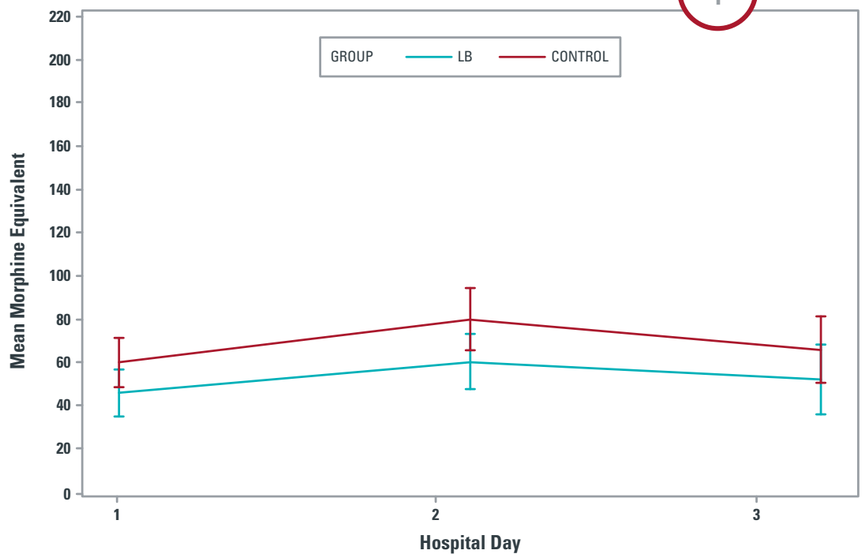
The use of liposomal bupivacaine shows promise as an adjuvant for postoperative analgesia in lumbar spine surgery with diminished pain scores, length of stay, and narcotic use. Further investigation with a larger prospective randomized study is warranted to better understand its potential benefit.

Table 1: Length of Stay by Procedure Type & Treatment Group

Type of Procedure	Treatment Group	Total Number Observed	Average LOS (Days)	Minimum LOS (Days)	Maximum LOS (Days)
Isolated Decompression	LB	16	0.56	0	2
	Control	9	1.33	0	3
Single-Level Fusion	LB	16	2.62	1	4
	Control	21	2.62	1	4
Two-Level Fusion	LB	10	2.50	1	4
	Control	13	3.08	2	5
≥ Three-Level Fusion	LB	10	3.00	1	5
	Control	9	3.89	2	5
Total	LB	52	2.04	0	5
	Control	52	2.73	0	5

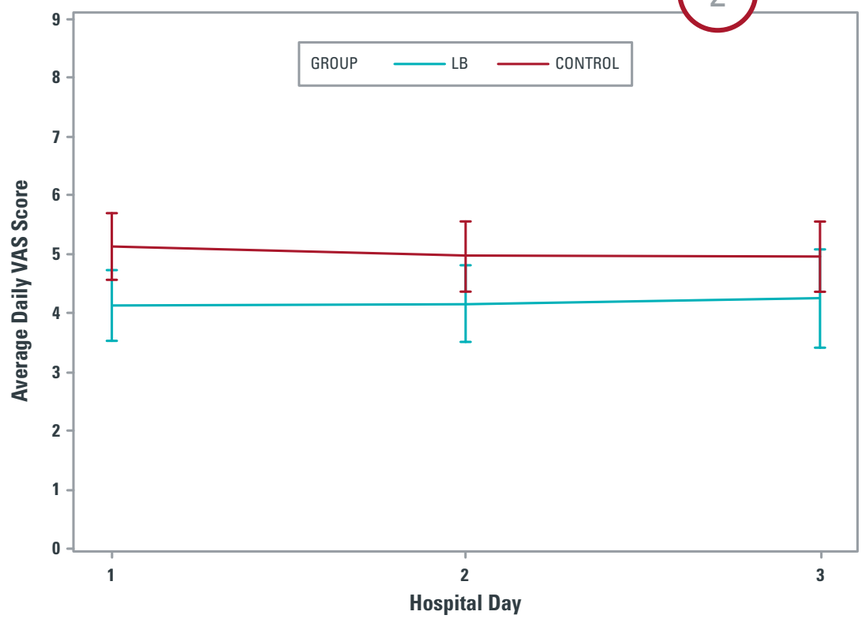
Average Daily VAS Score

1



Average Morphine Equivalent

2



Lower friction and wear of highly cross-linked poly with phospholipid polymer surface treatments in ceramic on polyethylene total hip replacements: In vitro testing

[1]Haider H., [1]Weisenburger J.N., [2]Siskey R.L., [3,4]Kyomoto M., [2]Kurtz, S.M. and [1]Garvin K.L.

[1]Department of Orthopaedic Surgery and Rehabilitation, University of Nebraska Medical Center
[2]Exponent, Inc., Philadelphia / PA
[3]Department of Materials Engineering, The University of Tokyo, Tokyo, Japan
[4]Medical R&D Center, KYOCERA Corp., Shiga, Japan

INTRODUCTION

The quest for lower wearing ultra-high-molecular-weight polyethylene (UHMWPE) for total hip replacements (THR) has progressed through various polymer technology advances to reduce the risk of osteolysis, loosening, and revision. Wear of small THRs was almost eradicated with highly cross-linked polyethylene (HXLPE) followed by remelting or annealing to preserve some of the mechanical properties (1-3). This was successful in small THRs so it brought the temptation to use HXLPE in larger THRs for the bigger jump distance and higher head-to-neck-ratio for less dislocation risk (4,5). Large hip sizes were only possible with thin bearing liners, risking fatigue/fracture due oxidation. The next significant advance was adding anti-oxidant vitamin E (Vit. E) (6). More of the mechanical properties were preserved in Vit. E stabilized HXLPE (7). Sequential annealing and crosslinking (8) and cold irradiated mechanical annealing (E-CIMA) (9) were other techniques to gain wear resistance from cross-linking, without compromising the mechanical properties or oxidative resistance.

However, none of the above managed to reduce THR friction and its contribution to wear. The subject of this study is an innovative surface grafting technique to HXLPE THR bearings using a biocompatible-phospholipid-polymer poly(2-methacryloyloxyethyl phosphorylcholine) (PMPC). This hydrophilic surface treatment mimics articular cartilage's tremendous lubricity and low friction (10, 11). The thin PMPC layer (~0.1 micrometer) is photo-inductively bonded to the HXLPE bearing through UV light (12-14). Its low friction comes from the highly hydrophilic nature demonstrated by its low contact angle with water or synovial fluid: less than 26° (15).

Various reports have been published by the developers of this PMPC grafting to demonstrate improved wear resistance through hip simulator studies, mostly on small THR sizes with metallic heads (12-14,16-18). None of those studies targeted the most ambitious combination, namely, a) large size THR, b) ceramic head, c) HXLPE bearings, d) with Vit. E. stabilization, and e) with prolonged wear testing up to 10 million simulated walking cycles (Mc). In this study we targeted such a ceramic on poly (COP) combination, with untreated controls.

MATERIALS AND METHODS

A hip wear test containing four test groups with N=3 was conducted to determine the wear rates of HXLPE material with and without PMPC grafting and with and without Vit. E against ZTA ceramic femoral heads. The details of the four UHMWPE bearing groups are shown in Table 1. The HXLPE controls and the PMPC-grafted investigational liners (groups 1 & 3) received a total gamma irradiation dose of 75 kGy, while the two vitamin E HXLPE groups (2 & 4) received a total dose of 125 kGy. The femoral heads were all 40 mm diameter ZTA ceramic (KYOCERA Corp.) and blue in color.

The bearing couples were tested using the waveforms of the standard test method of ISO 14242-1 (19) using an AMTI 12 station hip wear simulator. Testing was conducted to 10 Mc, stopping every 0.5 Mc for analysis. The gravimetric methods included a standardized cleaning and desiccation procedure. The mass losses of the wear components were corrected using loaded "active" soak control components. All testing was conducted with diluted bovine serum lubricant (30 g/L protein at 37°C). Frictional torque of each wear specimen was measured using a previously described method (20) to determine whether the PMPC grafting reduced friction at the head/liner interface, and if there was a difference in friction comparing liners with and without Vit. E.

RESULTS

The wear results (Fig. 1) showed some expected scatter but also clear trends. There was good linearity and narrow 95% confidence limit error bars for the control Group 1 (untreated, non-Vit. E), whose wear rate averaged 5.86±0.402 mg/Mc, typical of modern low-wearing HXLPE. The PMPC-grafted poly, specimen Group 3 average wear was 1.70±1.36 mg/Mc; a statistically significant 71% reduction in wear (p=0.013). The Vit. E HXLPE specimens (untreated control Group 2) liners averaged 2.14±0.269 mg/Mc, while wear of the PMPC-grafted version was 0.736±0.750 mg/Mc, which was another statistically significant 66% reduction in wear ($p = 0.035$). The wear rates of the untreated controls (Groups 1 and 2) were significantly different ($p = 0.0002$). However, no statistically significant difference had resulted between the two PMPC-grafted groups (Groups 3 and 4) ($p = 0.179$).

The average friction factor of each THR type over the entirety of the test (Fig. 2) was computed from the 21 individual friction readings of each of the 3 THRs of each liner type for a total of 63 friction readings for each THR type, along with a 95% confidence interval. Group 3 PMPC HXLPE showed the lowest friction factor (0.022 ± 0.001) which was statistically significantly lower than the friction factor of (0.028 ± 0.002) for the corresponding control Group 1 ($p < 0.001$). The Group 4 PMPC Vit. E HXLPE showed lower friction factors than their corresponding control Group 2 Vit. E HXLPE, (0.034 ± 0.002, 0.036 ± 0.004, respectively), although this difference was not significant ($p = 0.116$). HXLPE liners with Vit. E showed significantly higher friction that those without Vit. E in both the PMPC-grafted groups and the untreated groups (Group 1 vs. 2, $p < 0.001$; Groups 3 vs. 4, $p < 0.001$).

DISCUSSION

We confirmed a significant decrease in wear rate between Groups 1 & 3, and between Groups 2 & 4. The study was adequately powered to detect the effect of the PMPC-grafted surface treatment in each comparison. We also characterized THR friction in the form of friction "factor" as it normalizes the frictional torques by the size of the hip, and represents friction in all dimensions independent of hip size (20). All four groups generally showed relatively low friction compared to what we have published before; almost half the friction of MOP without the PMPC grafting studied here (20). We attribute this to the higher wettability and lubricity of the ceramic femoral heads used here (21).

The PMPC-grafted THRs of the current study showed lower friction than their respective (untreated) control groups, which was a statistically significant difference in the non-Vit. E THRs. This corroborated the link between wear reduction and lower friction. A surprising result was the higher friction for the Vit. E HXLPE compared to the ones without Vit. E. This has been observed before in other frictional measurements from our lab, and published *in vitro* one-dimensional rotational friction measurements (22). However, this trend was contradicted by (23), and by more recent comprehensive 3-dimensional frictional measurements (24). We cannot speculate at this stage what the actual mechanical reason for this, beyond possible compromise in the porosity of the UHMWPE with an oily material such as Vit. E and possible effects on contact angle and wettability.

The early studies on this type of coating focused on the smaller hip sizes (e.g., 26 mm diameter) perhaps because of the Japanese/Asian population in and for which it was first developed and for which more clinical studies are now being performed (25). Our study has subjected this PMPC grafting to a prolonged 10 Mc test in a high-end THR configuration combining large femoral head size, advanced form of ceramic head material, very HXLPE and stabilized with Vit. E. The PMPC grafting could still measurably and coherently be seen to improve wear.

Our hip simulator study took almost a year to plan and perform, but still had several limitations. The most important is that we did not repeat or perform the same test under high abrasion conditions. Such conditions could arise *in vitro*, due to bone and cement debris, taper corrosion products, scratched femoral heads (although less likely with ceramics) and even edge loading. It is possible that a sub-micrometer thick coating like PMPC may suffer under such conditions, and this is yet to be found out from in vitro or clinical studies. But, on the other hand, such an extreme condition test would not be warranted until the PMPC grafting is demonstrated to improve wear even for the top end advanced hip bearing materials and sizes as was done here.

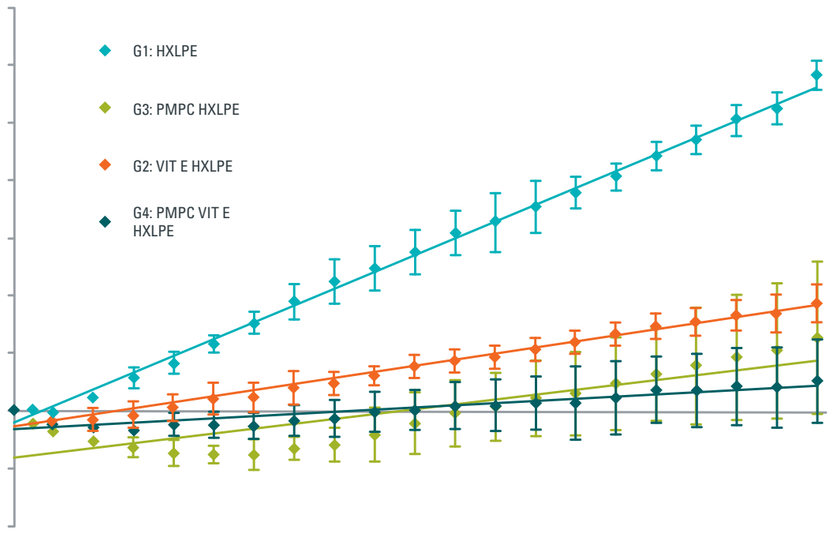
Our conclusions are that the grafting of PMPC onto a HXLPE, with or without Vit. E, produced measurable, statistically significant wear and frictional reductions which we think promise clinical benefits for future patients. These results were an important step in the quest for lower wearing, thin and strong HXLPE liners for larger diameter femoral heads with the potential benefit of longevity and less risk of dislocation after surgery.

Table 1: Hip simulator test specimen matrix

Study Group (# - Name)	Resin	Crosslinking Dose (kGy)	PMPC Grafting	Sterilization	Femoral Counterface	Wear Stations	Load Soak Stations
1 –HXLPE (Control)	GUR 1020	75	No	Gas Plasma	Ceramic	n = 3	n = 2
2 – Vit. E HXLPE (Control)	GUR 1020	100	No	25 kGy γ-irradiation	Ceramic	n = 3	n = 2
3 – PMPC-Grafted HXLPE	GUR 1020	50	Yes	25 kGy γ-irradiation	Ceramic	n = 3	n = 2
4 – PMPC-Grafted Vit. E HXLPE	GUR 1020	100	Yes	25 kGy γ-irradiation	Ceramic	n = 3	n = 2

Average wear rates of the HXLPE and Vit E HXLPW acetabular liners with and without the PMPC grafting.

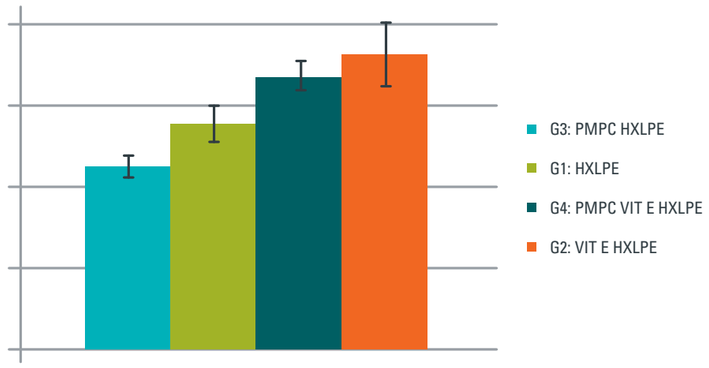
1



The data point symbols represent averages for all specimens in the group with 95% confidence intervals, and a least-squares-error straight line slope, intercept, and R2 parameters shown.

Average friction factor of COP THR components over 10 Mc with 95% confidence interval bars.

2



Averaging was of 21 friction readings from each of the three THR specimens of that type (63 total measurements for each HXLPE type).

REFERENCES

1. Kurtz SM, Gawel HA, Patel JD. History and systematic review of wear and osteolysis outcomes for first-generation highly crosslinked polyethylene. Clin Orthop Relat Res 2011 Aug;469(8):2262-2277.
2. Paxton EW, Inacio MC, Namba RS, Love R, Kurtz SM. Metal-on-conventional polyethylene total hip arthroplasty bearing surfaces have a higher risk of revision than metal-on-highly crosslinked polyethylene: results from a US registry. Clin Orthop Relat Res 2015 Mar;473(3):1011-1021.
3. Garvin KL, White TC, Dusad A, Hartman CW, Martell J. Low wear rates seen in THAs with highly crosslinked polyethylene at 9 to 14 years in patients younger than age 50 years. Clin Orthop Relat Res 2015 Dec;473(12):3829-3835.
4. Crowninshield RD, Maloney WJ, Wentz DH, Humphrey SM, Blanchard CR. Biomechanics of large femoral heads: what they do and don't do. Clin Orthop Relat Res 2004 Dec;(429)(429):102-107.
5. Burroughs BR, Hallstrom B, Golladay GJ, Hoeffel D, Harris WH. Range of motion and stability in total hip arthroplasty with 28-, 32-, 38-, and 44-mm femoral head sizes. J Arthroplasty 2005 Jan;20(1):11-19.
6. Oral E, Malhi AS, Wannomae KK, Muratoglu OK. Highly cross-linked ultrahigh molecular weight polyethylene with improved fatigue resistance for total joint arthroplasty: recipient of the 2006 Hap Paul Award. J Arthroplasty 2008 Oct;23(7):1037-1044.
7. Haider H, Weisenburger JN, Kurtz SM, Rimnac CM, Freedman J, Schroeder DW, et al. Does vitamin E-stabilized ultrahigh-molecular-weight polyethylene address concerns of cross-linked polyethylene in total knee arthroplasty? J Arthroplasty 2012 Mar;27(3):461-469.
8. Dumbleton JH, D'Antonio JA, Manley MT, Capello WN, Wang A. The basis for a second-generation highly cross-linked UHMWPE. Clin Orthop Relat Res 2006 Dec;453:265-271.
9. Oral E, Wannomae KK, Hawkins N, Harris WH, Muratoglu OK. Alpha-tocopherol-doped irradiated UHMWPE for high fatigue resistance and low wear. Biomaterials 2004 Nov;25(24):5515-5522.
10. Mankin HJ, Mow VC, Buckwalter JA, Iannotti JP editor. Orthopaedic Basic Science. Chicago: American Academy of Orthopaedic Surgery; 1994.
11. Takatori Y, Moro T, Ishihara K, Kamogawa M, Oda H, Umeyama T, et al. Clinical and radiographic outcomes of total hip replacement with poly(2-methacryloyloxyethyl phosphorylcholine)-grafted highly cross-linked polyethylene liners: three-year results of a prospective consecutive series. Mod Rheumatol 2015 Mar;25(2):286-291.
12. Moro T, Takatori Y, Ishihara K, Nakamura K, Kawaguchi H. 2006 Frank Stinchfield Award: grafting of biocompatible polymer for longevity of artificial hip joints. Clin Orthop Relat Res 2006 Dec;453:58-63.
13. Kyomoto M, Moro T, Miyaji F, Hashimoto M, Kawaguchi H, Takatori Y, et al. Effect of 2-methacryloyloxyethyl phosphorylcholine concentration on photo-induced graft polymerization of polyethylene in reducing the wear of orthopaedic bearing surface. J Biomed Mater Res A 2008 Aug;86(2):439-447.
14. Kyomoto M, Moro T, Yamane S, Hashimoto M, Takatori Y, Ishihara K. Effect of UV-irradiation intensity on graft polymerization of 2-methacryloyloxyethyl phosphorylcholine on orthopedic bearing substrate. J Biomed Mater Res A 2014 Sep;102(9):3012-3023.
15. Kyomoto M, Moro T, Takatori Y, Tanaka S, Ishihara K. Multidirectional wear and impact-to-wear tests of phospholipid-polymer-grafted and vitamin E-blended crosslinked polyethylene: a pilot study. Clin Orthop Relat Res 2015 Mar;473(3):942-951.
16. Moro T, Kawaguchi H, Ishihara K, Kyomoto M, Karita T, Ito H, et al. Wear resistance of artificial hip joints with poly(2-methacryloyloxyethyl phosphorylcholine) grafted polyethylene: comparisons with the effect of polyethylene cross-linking and ceramic femoral heads. Biomaterials 2009 Jun;30(16):2995-3001.
17. Moro T, Kyomoto M, Ishihara K, Saiga K, Hashimoto M, Tanaka S, et al. Grafting of poly(2-methacryloyloxyethyl phosphorylcholine) on polyethylene liner in artificial hip joints reduces production of wear particles. J Mech Behav Biomed Mater 2014 Mar;31:100-106.
18. Kyomoto M, Moro T, Yamane S, Watanabe K, Hashimoto M, Takatori Y, et al. Poly(2-methacryloyloxyethyl phosphorylcholine) grafting and vitamin E blending for high wear resistance and oxidative stability of orthopedic bearings. Biomaterials 2014 Aug;35(25):6677-6686.
19. ISO 14242-1:2012 - Implants for surgery -- Wear of total hip-joint prostheses -- Part 1: Loading and displacement parameters for wear-testing machines and corresponding environmental conditions for test. 2012.
20. Haider H, Weisenburger JN, Garvin KL. Simultaneous measurement of friction and wear in hip simulators. Proc Inst Mech Eng H 2016 May;230(5):373-388.
21. Agathopoulos S, Nikolopoulos P. Wettability and interfacial interactions in bioceramic-body-liquid systems. J Biomed Mater Res 1995 Apr;29(4):421-429.
22. Meneghini RM, Lovro LR, Wallace JM, Ziemba-Davis M. Large Metal Heads and Vitamin E Polyethylene Increase Frictional Torque in Total Hip Arthroplasty. J Arthroplasty 2016 Mar;31(3):710-714.
23. Sagbasa BaD, M.N. Surface Texturing of Vitamin E Blended UHMWPE for Reduction of Wear. Acta Physica Polonica A 2014;125.
24. Kaddick C, Kretzer JP. Letter to the Editor on "Large Metal Heads and Vitamin E Polyethylene Increase Frictional Torque in Total Hip Arthroplasty". J Arthroplasty 2016 Oct;31(10):2375-2376.
25. Moro T, Takatori Y, Tanaka S, Ishihara K, Oda H, Kim YT, et al. Clinical safety and wear resistance of the phospholipid polymer-grafted highly cross-linked polyethylene liner. J Orthop Res 2017 Sep;35(9):2007-2016.

Challenging the doctrine that larger surface contact area reduces wear of Total Knee Replacements?

[1]Haider, H., Weisenburger, J.N., Konigsberg, B.S., Hartman, C.W. and Garvin, K.L.

[1]Department of Orthopaedic Surgery and Rehabilitation, University of Nebraska Medical Center

ABSTRACT

From the onset of Total Knee Replacement (TKR) design, it is known that large articular contact surface area is sought to reduce stress to reduce wear of the UHMWPE tibial bearings. Early generations of UHMWPE TKR bearings showed excessive wear due to delamination by stress fatigue, caused by oxidation from sterilization by gamma radiation in air, and from excessive shelf lives. Reducing stress with higher contact area was a wise solution then, but came at a price of higher TKR constraint. The latter could curtail range of motion and impart higher forces and torques to the bone or cement interface and risk implant loosening. In this study we questioned the widely held belief that higher contact area leads to lower wear in modern TKR designs and materials where the risk of delamination fatigue wear has been largely eradicated.

We pooled data from eight full-scale knee wear simulator tests performed in our lab on different TKR designs, materials and conditions. Each test had a sample size range of 2-4 per sub-group and compared the wear rate of large versus small(er) size TKRs which were otherwise identical in every way. TKR sizes ware used as surrogate to represent contact areas by scaling, but it may have also increased sliding distances as a confounding variable. We used the same force-control testing methodology of ISO 14243-1&2 simulating human walking, under the same dynamic multi-axial loads, The UHMWPE wear was measured gravimetrically in tests which ran for at least 5 million cycles (MC), except for two shorter (2 MC) tests with accelerated abrasive wear conditions. Statistical significant difference tests compared between the wear of larger and smaller TKRs in each group. In all the tests, the anterior-posterior (AP) linear and internal-external (IE) rotational kinematics were measured form the force-controlled simulator and also compared, to assess the effect of TKR size on kinematics, and the effect of the resulting accumulated sliding distances per cycle on wear as confounding variables. The wear scar (patch) areas were also measured at the end of each test. Six separate correlation analyses were performed to see if the higher accumulated sliding distances expected with larger TKR sizes could have been the main reason behind extra wear, and if those kinematics and wear scar/patch areas correlated with extra wear too.

None of UHMWPE bearings of the 14 sub-groups (7 pairs of large vs. small sub-groups) showed any signs of delamination wear. The wear rates varied among the TKR designs and UHMWPE materials, and, as expected, the extra abrasion tests showed significantly higher wear ($p<<0.050$) than their respective controls. In all the eight tests including the two extra-abrasive tests, the wear of the larger size TKR was statistically significantly higher ($p\leq0.05$) than its equivalent smaller version. The difference in wear (size effect) varied since the difference in sizes of the implants tested was not the same. The correlation analyses failed to attribute this wear increase solely or even primarily to increased sliding distances.

Our study associated increasing TKR size with increased wear, primarily due to contact area differences. Decreasing contact area is not a good general solution however, as excessively higher contact pressure/stress would result with contact areas too small, turning the trend into higher wear. Therefore, an optimum contact area should be chosen to balance these effects, selected primarily for optimum constraint for better TKR function.

Similar findings to this study could be interpreted from some published pin-on-disk test results, other TKR tests, and of course from total hip replacements. Larger hips are known to wear more than smaller ones under the same loads despite their lower contact stresses, due to larger contact areas and sliding distances. Our data sheds doubt on the previous doctrine, offering a new beacon to guide future knee designers to be wary of excessively high TKR contact area. With everything else equal, larger TKRs wear more than smaller ones. With equally sized contemporary designs and similar kinematics, a TKR with more conforming articular surfaces may wear more than less-conforming designs. With modern materials and processing, increasing contact area to decrease contact stress may be counter-productive and may result in increased wear.

INTRODUCTION

PPolyethylene wear in total knee replacements (TKR) is multifactorial and needs to be minimized [6] as it remains one of the causes of failure through instability, inflammation and pain or severe wear debris induced osteolysis requiring revision surgery [14, 15]. Component design remains a significant contributing factor. From the onset of Total Knee Replacement (TKR) design, the doctrine has been to have large articular contact surface area to reduce stress to reduce wear of the UHMWPE tibial bearing [9]. Early generations of UHMWPE TKR bearings showed excessive wear due to delamination by a stress/fatigue type of wear caused by oxidation from sterilization by gamma radiation in air and excessive shelf lives [5, 23, [25]. It is caused by dynamic multidirectional subsurface (cross) shear stresses, the peak values of which initiate many cracks about 1 mm under the surface [5, 11]. Such severe wear drastically accelerated the onset of osteolysis leading to failure and complex revision reconstructions. Reducing stress by increasing contact area was therefore a very wise solution at that time. However, it does come at a price.

Increasing contact area is typically accomplished by increasing sagittal and/or coronal surface conformity which in turn increases the TKR constraint. Higher constraint may curtail the flexional range of motion, tibio-femoral anterior-posterior (AP) translation and/or internal-external (IE) rotation. It also requires more exacting soft tissue balancing to maintain knee ranges of motion and the desired knee stability. Higher (than necessary) constraint also causes higher forces and torques to be transmitted to the bone or its cement interface and risk implant loosening.

Meanwhile, in the last 20 years, the above type of dramatic TKR wear has since been largely eradicated due to great improvements in UHWMPE processing which avoid excessive oxidation of UHMWPE bearings. Instead of sterilization of UHMWPE in air, sterilization by radiation in an inert (oxygen free) gas has become the norm [20]. The long shelf life of implants before clinical use was also avoided. Of course, some oxidation of UHMWPE continues to occur in the body after implantation [19] but this is a slow process.

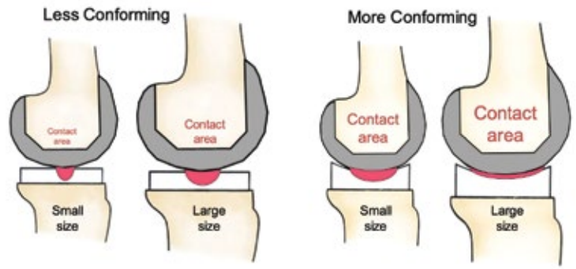
High stress risers in the articulating surfaces of UHMWPE bearings are exceedingly less usual with contemporary knee implant designs. For example, Bartel. et. al. [3] reported from a Finite Element Analysis study that excessive stresses would result with polyethylene inserts of less than 6mm thickness, and therefore thinner UHMWPE TKR bearings are no longer cleared by regulatory authorities for clinical use, and seldom found anymore. Better locking mechanisms, various techniques of crosslinking of UHMWPE and anti-oxidant stabilization have also advanced to further lessen delamination as a cause of failure.

On the other hand, much like in total hip arthroplasty, the larger the TKR size, the larger its articular surface contact area would be (see illustration in Fig. 1), and the larger its motions will be, which both mean more surfaces rub against each other, resulting in a higher chance for removal of tiny surface asperities which represents the Mode 1 “adhesive” type of wear. And the same could be said about Mode 2, “abrasive” wear; the more the articular contact surface area, the more the likelihood of third body bone or cement debris particles that can get trapped and cause abrasion. These less severe wear mechanisms, sometimes described as “surface wear”, are the predominant ones today, resulting in shedding of submicron-sized particles and leading to osteolysis [15, 18, 24].

Therefore, with contemporary TKR designs where stresses are moderate, and modern UHMWPE formulations and processing, we now question the historic belief that higher contact area would really reduce TKR wear, and suspected if it would be the opposite. Helping our case was another confounding factor, that larger TKR sizes (dimensionally scaled) would by definition involve higher motions, and those may also increase wear, making it too reasons for higher wear with larger TKR sizes. We answer these questions from the results of a series of multiple well-controlled in vitro knee simulator tests.

TKR design

1



Larger size TKR and more conforming design TKRs have larger articular surface contact area.

Continued

MATERIALS AND METHODS

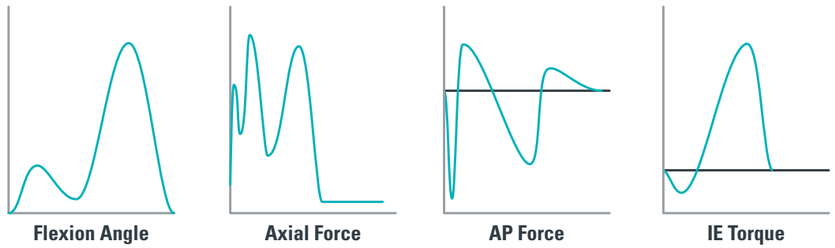
TKR simulator testing

We evaluated the data from eight separate full-scale knee wear simulator tests conducted in our lab on different TKR designs, materials and conditions. Each test had a sample size range of 2-4 per sub-group, compared the wear rate of a larger versus a smaller size TKR which were otherwise identical in every way. A priori power analyses on two separate wear tests from our lab both showed a minimum sample number needed per size group of n=2, for 85% statistical power, based on 0.05 alpha error. The size of the TKR was defined as the medial-lateral width of the femoral component at its widest point. This was measured in house, and was used instead of the implant manufacturer's nominal numerical or letter sizing label for ease of comparison across implant manufacturers.

We realize that TKR size is primarily chosen during surgery based on the anatomy of the patient. In this study we treated TKR size as the independent variable in each of the groups above assessing how it might have affected wear as a surrogate marker for articular surface contact area, and as size influencing sliding distances under the same test loading regime. For a given same design and materials, a larger TKR size, due to dimensional scaling alone, should have a larger contact area patch compared to a smaller size. The TKR actual contact area of interest in our tests varied depending on the relative posture/pose (kinematic position) of the femoral and tibial components during various stages of a walking gait cycle in the wear tests, thus strongly varied with flexion, AP position and IE rotation. It would have been too complex to choose which combination of these three kinematic variables in a walking gait cycle to estimate contact area at, and whether only during the stance or swing phase or both. In addition to TKR size as a marker for surface contact area, we also estimated the nominal contact area by measuring the wear patch on the UHMWPE tibial bearings after each test, as will be described at the end of this section.

Force controlled waveforms

2



Force controlled waveforms prescribed by ISO 14243-1, which was applied at 1 Hz to all wear specimens for the duration of the wear study.

Five different posterior stabilized (PS) designs, and one CR design, were tested, where each design group had two TKR sizes tested as sub-groups. The sizes, number of specimens tested, and details of UHMWPE bearing material formulation are all specified together with the resulting plots in Figs. 5-11.

All the testing was conducted on 4-station Instron Stanmore Knee simulators. We used the same force-control testing methodology of ISO 14243-1&2 [16, 17] simulating human walking, under the same dynamic multi-axial loads, at 1Hz frequency and 37°C temperature, with diluted bovine serum lubrication with 20 g/l protein concentration . [10, 11] Soft tissue simulation to restrain or limit the motions was also provided, as AP and IE constraints. These were non-linear in stiffness and mimicked the s-curve of the physiological soft tissue restraint with less constraint stiffness just around the neutral positon and higher stiffness away from that position [10]. The mechanical constraint simulation models in the simulator had two standard configurations, one for PCL retaining (CR) TKR systems, and for PCL sacrificing (PS) TKRs.

Additionally, two shorter (2 Mc) tests were conducted with accelerated abrasive wear conditions using femoral components which were deliberately pre-scratched as they would be after years in vivo (Fig. 3). The scratching procedure (setup shown in Fig. 4).involved pressing the femoral components into a box of abrasive beads with a force of 712 N (approx. one bodyweight) and then rotating the femoral component internally then externally by 15° (while at 0° flexion), then flexing the femoral from 0° to 58°, and then back to 0°. This was repeated a total of 10 times on each femoral component, producing scratches that were random in location, but repeatable in severity.

During each and all the simulator tests, data was logged at a multitude of times. Each acquisition recorded logged all the following variables in 20 consecutive walking cycles at 50 times per cycle, and the results averaged at equivalent phase cycle phases to represent the dynamic waveform of that variable in 1 cycle. The variables logged and processed as such were Anterior-Posterior (AP) and Internal-External (IE) kinematics, as well as flexion angle, compressive force, AP force and IE torque of each specimen, and the spring soft-tissue forces and torques which were provided by the non-linear spring assemblies.

Wear measurements

All the tests ran for at least 5 million cycles (Mc) which loosely approximated the TKR patient walking for 5 years, except for one test on 80mm PS TKRs that ran for only 1 Mc.

The UHMWPE wear was measured gravimetrically after correction with loaded liquid-absorption (soak) "controls". Measurements were made at frequent intervals (at 0, 0.1 Mc, and then every 0.5 Mc thereafter).

The least square error method was used to calculate the slope of the best fit linear regression line through the individual wear curves (wear versus cycles of a specific test specimen in a specific test), to result in an average "wear rate" for that tested TKR design, material and size specimen. We emphasize that in each of the wear tests described above, the TKR size was the only variable in the comparison, with all others (TKR design, materials, test conditions, etc) staying the same. Once the mean and standard deviation of the resulting wear rates of the larger size TKR in a given test were determined they were compared with those of the smaller size TKRs in that same test (Figs. 9 & 10). The student t test was conducted on each of the seven tests to calculate the one-tailed p value of rejecting a null hypotheses, that any differences between the wear of the two corresponding sub-groups (large and smaller size TKR) would be due to chance, and not only due to size/contact area alone.

For more detail in this paper (Figs. 5-8) a single combined linear regression plot of wear is shown representing the larger specimens of a given design, and the smaller, showing through their error bars the (95% confidence limits) scatter of the wear measurements at each of the test intervals.

The composite bar chart of Fig. 10 summarizes the full test matrix and wear results, showing for each test (column/pair of bars) the TKR design, material, size groups compared, post-hoc (a posteriori) statistical power, and p value of the wear comparison. Two sub-groups related to extra abrasive tests on two UHMWPE materials. These abrasive tests were carried out together with (non-scratched) "control" equivalents in the chart of Fig. 9, so the chart of Fig. 10 had the rightmost 4 pairs representing one TKR manufacturer's generic design. Another two of the subgroups were labelled with everything including size the same, except for different surface conformity and thus different contact area (Fig. 11, and shown as part of Fig. 10).

3



Figure 3: *Femoral components before (left) and after the scratching procedure (right). (The "before" picture was taken after the femoral component had already undergone a standard non-abrasive wear test.)*

4

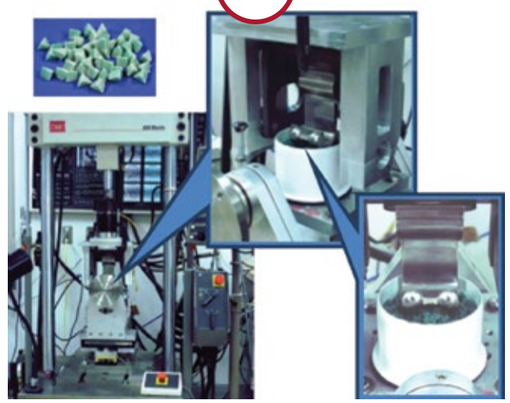


Figure 4: *Setup for scratching the femoral components for abrasive testing. Abrasive beads (upper left) and the MTS system used for scratching are shown.*

Kinematic path length measurements

To assess the role of TKR size on kinematics, and the contribution of the latter on wear as a confounding variable, we measured and computed the mean accumulated AP disp. & IE rotation path lengths/cycle. For every test, the AP and IE kinematics were measured using the force-control knee simulator instrumentation for 50 points per cycle averaged over 20 walking gait test cycles at a point in the test. The total accumulated path in the AP direction was summed up so that all anterior and posterior reversals added as the total distance traversed in that representative walker cycle. The total distance from such a log, concerning one specimen at one point in a (say 5 million cycle) test, were then averaged over various points throughout the test. It was finally averaged again over various specimens representing that TKR (sub-group) of TKR design, materials and size. The mean and std. dev. for that subgroup were the result. In similar data processing we computed the accumulated IE rotation per cycle, to produce the average total accumulated IE angle sweep in a cycle for each subgroup with its std dev. The results above were then compared for each test for significant differences between large and small size TKRs using the student t test.

Wear patch area measurements

We had shown in the manuscript the wear patch area with boundaries around them on the photos of TKR specimens taken after wear testing. Photos of the articulating surfaces of all wear specimens were taken at the conclusion of each wear test study. The edge of the wear patch was

Continued

estimated first by eye with the specimen in hand, and then thinly outlined on the photograph of the specimen using a freehand computer draw tool. The photo of the patch and boundary were then uploaded to SketchAndCalc™, which is an online tool for accurately measuring perimeters and areas of odd/irregular shapes. On each photo, a straight line had been drawn by us alongside, coinciding with the width of the TKR bearing which was known from its size in mm. The graphic of the line, and its associated length in mm, was used by the software like a ruler to scale the area calculated into the appropriate units. The outline of the wear patch in the photo was followed/outlined again using the freehand outline tool in SketchAndCalc™ on both the medial and lateral sides of the tibial component and the online algorithm output the areas of both the medial and lateral wear regions in cm2. These areas were then summed to give the overall wear patch area for that specimen. Once all specimens of a sub-group of a given size/type had been measured, the overall wear path areas were averaged to give a mean and standard deviation for the wear patch of that given sub-group of specimens.

Further post processing and correlation analyses

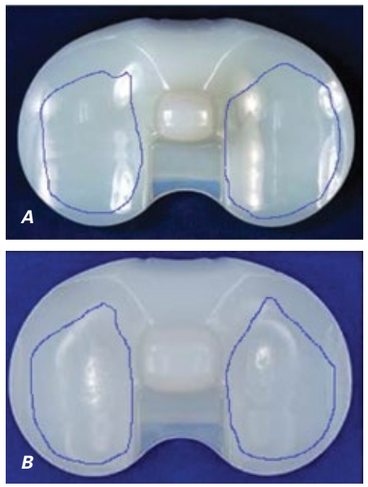
We performed six extra plots to examine the level of correlation between the main and confounding variables described earlier, to examine which had the biggest effect on wear. For example, we first examined the correlation between wear rate and the measured kinematics, and the latter with TKR size, and the correlation coefficients of these two pairs were compared to that between the main percentage TKR and TKR size. We also assessed similar correlation coefficients between the resulting wear patch area with TKR size, wear rate with patch area, and the accumulated AP path length with patch area.

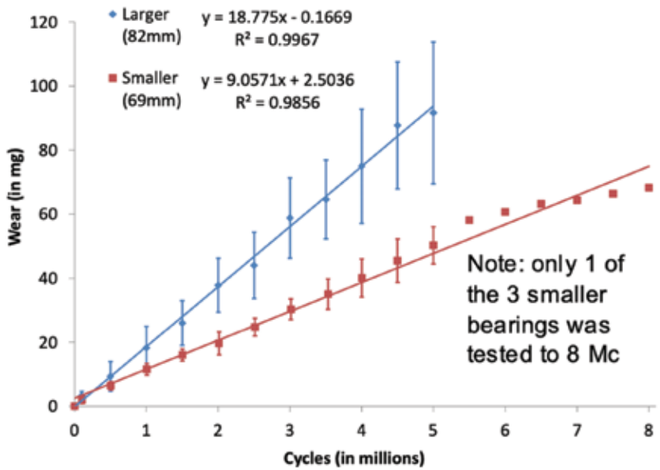
RESULTS

The wear rates varied among the TKR designs and UHMWPE materials, and, as expected, the two extra abrasion tests showed significantly higher wear ($p<<0.05$) than their respective controls. None of UHMWPE bearings of the 12 sub-groups (6 pairs of large vs. small sub-groups) showed any signs of delamination wear. Only adhesive and abrasive modes of wear were evident through some pitting and the usual shiny and blemished areas (Figs. 5-9 and 11).

Results from the 82mm vs. 69mm PS TKR test

5





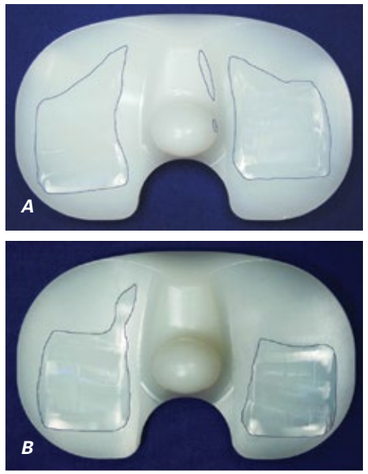
A *82mm, 25-40 kGy, N=4*
19.8 ± 4.23 mg/Mc

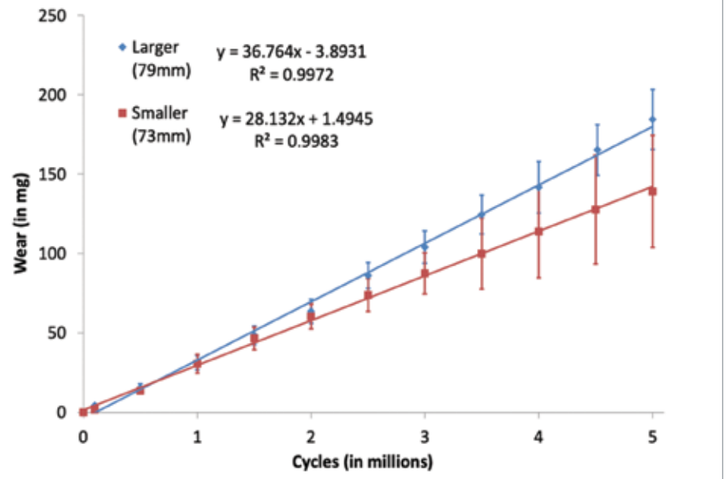
B *69mm, 25-40 kGy,N=3*
9.06 ± 0.10 mg/Mc

Significantly different, p = 0.0038, 96.3% powered

Results from the 79mm vs. 73mm PS TKR test

6





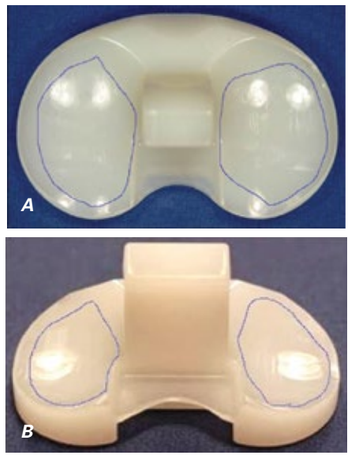
A *79mm, 25-40 kGy, N=4*
36.8 ± 3.71 mg/Mc

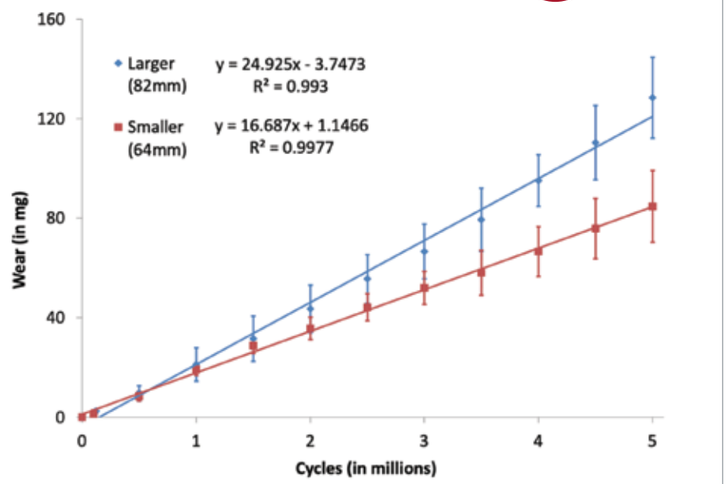
B *73mm, 25-40 kGy,N=2*
28.1 ± 5.25 mg/Mc

Significantly different, p = 0.0367, but only 70.8% powered, likely due to similarity in size.

Results from the 82mm vs. 64mm high constraints PS TKR test

7





A *82mm, 25-40 kGy, N=4*
24.9 ± 2.94 mg/Mc

B *64mm, 25-40 kGy,N=4*
16.7 ± 3.02 mg/Mc

Significantly different, p = 0.004, but only 96.8% powered
Note: High Constraint design

Continued

In all the eight tests including the two extra-abrasive tests, the wear of the larger size TKR was statistically significantly higher ($p \leq 0.05$) than its equivalent smaller version (Figs. 5-10). The difference in wear (size effect) varied since the difference in sizes of the implants tested was not the same. Overall, the larger size TKRs had greater wear rate than the smaller size ones (Figs. 5-11).

The TKR Kinematics also varied among the tests due to multiple factors, including the TKR size. The accumulated AP path lengths per test cycle varied almost consistently, and were larger for the larger TKR sizes in 7 out of 8 tests but the difference was statistically significant in only 3 out of 8 tests (Fig. 12). The accumulated IE rotational swept angles per cycle also varied widely among the tests but there was no overall trend or consistent difference or association between those rotations and TKR size (Fig. 13).

The results of the wear scar patch areas showed them to be consistently and statistically significantly ($p \leq 0.011$) larger for the corresponding smaller ones wear patches than their corresponding smaller ones (Fig. 14).

The correlation analysis plots (Fig. 15) showed the AP accumulated motion paths did not correlate with wear (Fig. 15 a) , nor with TKR size (Fig. 15 b), with a negative correlation coefficient, R, to be noted in both cases. In contrast, the wear rate somewhat correlated with the TKR size (Fig. 15 c), with a positive correlation coefficient. When TKR size increased, wear always also increased, with a modest but positive correlation coefficient R=0.42. Interestingly, wear patch size proved to have poor correlation with TKR size (Fig. 15 d), with wear rate (Fig. 15 e), and even of AP path length (Fig. 15 f).

With respect to the TKR kinematics measured, the results showed the total AP relative motions (Fig. 12) were larger for the larger TKR sizes in 7 out of 8 cases/tests, and statistically significantly so in only 3 out of 8. The results of the total IE angle swept measurements showed no overall trend or difference between large and small TKR sizes, nor was one expected. If anything, those total angles were smaller for the larger TKR sizes in 6 out of 8 tests but those differences were statistically significant in only 2 out of the 6 cases.

The wear patch area in all eight tests (Fig. 14) was statistically significantly bigger for the larger TKR implant sizes compared to the smaller ones ($p<0.011$)..

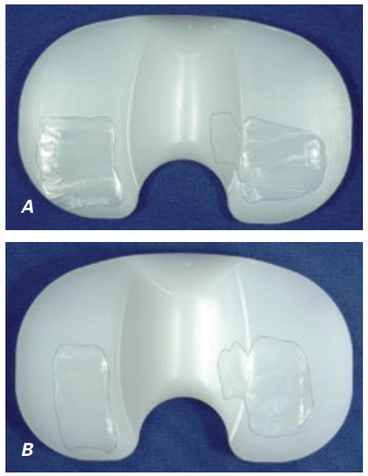
DISCUSSION AND CONCLUSIONS

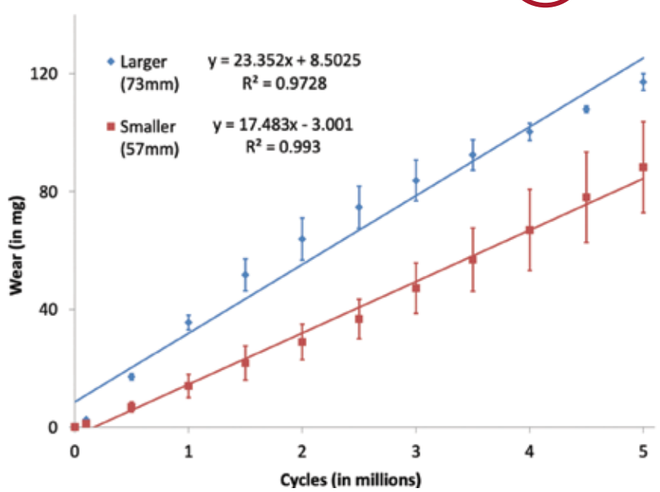
Load, stress, contact area, cross shear and of course sliding distance affect the wear of UHMWPE in joint replacement bearings. Our focus here was the contact area varied by TKR size with sliding distance as a confounding variable. All our results clearly showed that contact area as surrogated by TKR size had increased and not reduced wear, and thereby that partly answered our main question. In terms of percentages, the wear changes correlated to the TKR size changes with a positive correlation coefficient.

Could this extra wear with TKR size be partly due to the larger sliding distances of larger TKRs? Among the important questions was which of the

Results from the 73mm vs. 57mm CR TKR test

8





A *73mm, EtO sterilized, N=2*
23.4 ± 0.098 mg/Mc

B *57mm, EtO sterilized, N=2*
17.5 ± 2.27 mg/Mc

Significantly different, p = 0.045, 85.7% powered

Results from the 80mm vs. 53mm PS TKR test

9





A *80mm, EtO sterilized, N=2*
Clean: *19.1 ± 1.75 mg/Mc*
Abrasive: *59.2 ± 11.7 mg/Mc*

B *53mm, EtO sterilized, N=4*
Clean: *7.73 ± 0.805 mg/Mc*
Abrasive: *29.0 ± 2.56 mg/Mc*

Clean: *Significantly different p = 0.0001 100% power*
Abrasive: *Significantly different p = 0.0025 100% power*



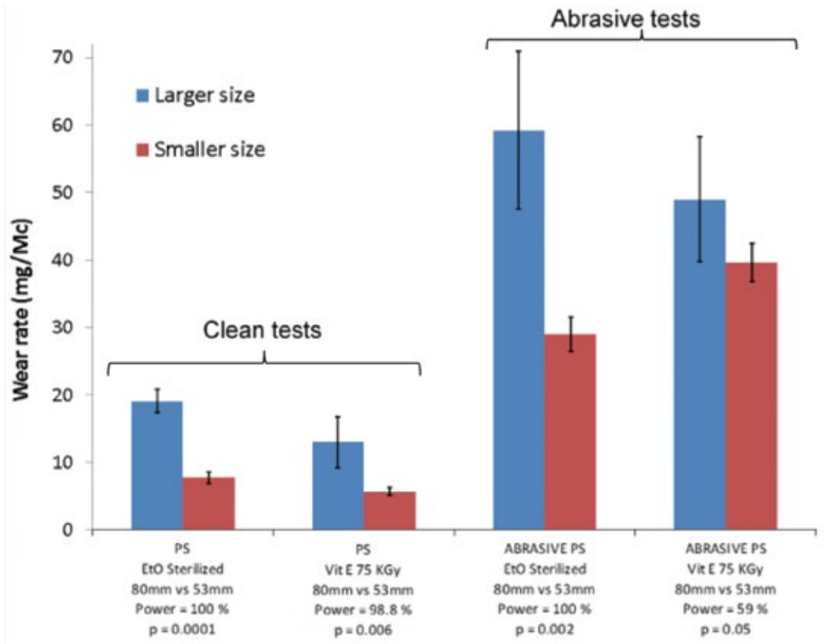


A *80mm, HXL Vit.E, N=2*
Clean: *13.0 ± 3.78 mg/Mc*
Abrasive: *49.0 ± 9.26 mg/Mc*

B *53mm, HXL Vit.E, N=4*
Clean: *5.66 ± 0.599 mg/Mc*
Abrasive: *39.6 ± 2.79 mg/Mc*

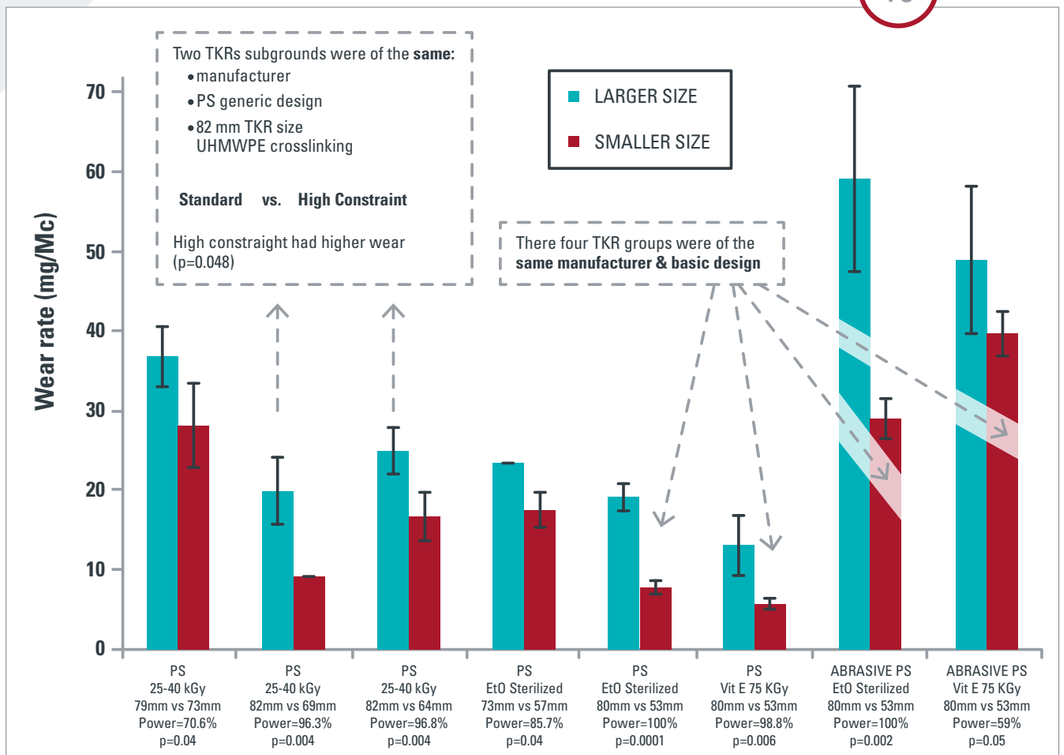
Clean: *Significantly different p = 0.0062 98.8% power*
Abrasive: *Significantly different p = 0.053 59% power*

This is four tests rolled into one, based on UHMWPE formulation (either EtO or HXL vitamin E), as well as abrasion.



Average wear rates of UHMWPE tibial bearings and standard deviation bars for all implant designs tested

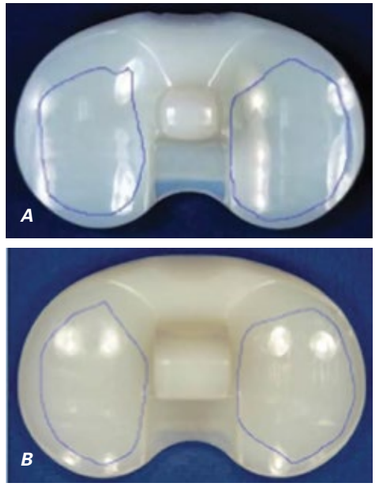
10



Each pair of bars represents two implant types that only differed in size, with the larger shown in blue and the smaller shown in red.

Results from the standard vs higher constraint TKR comparison

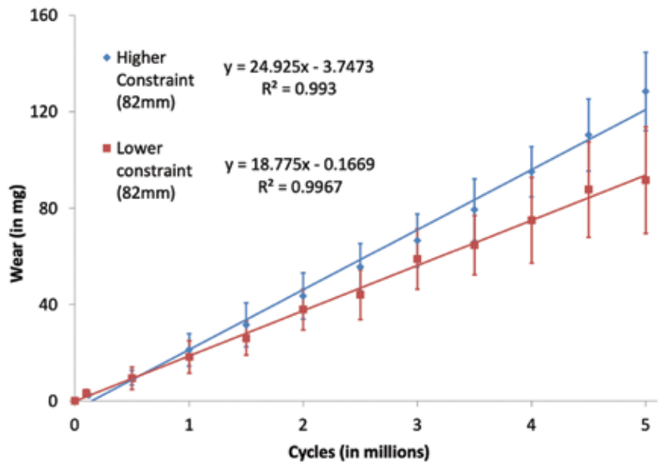
11



A *82mm, 25-40 kGy, N=4*
19.8 ± 4.23 mg/Mc

B *82mm, 25-40 kGy, N=4*
24.9 ± 2.94 mg/Mc

Significantly different, p = 0.048



Both TKRs are from the same manufacturer and are the same size, but differ in articular surface conformity.

above contributed more to wear, contact area or sliding distances? This could not be deciphered directly without the extra analyses of kinematics, contact area patch estimates and the correlation plots to detect the strongest associations between them. All of those pointed to the higher contact area as the strongest culprit behind increasing wear in this study.

The IE accumulated rotation per cycle did not correlate with TKR size and nor was it expected to. A larger size TKR size does not have to have bigger angles of rotation or more angular excursions. However, understandably, the AP sliding distances should change with size, and they did jn this study as most of the accumulated AP sliding excursion distances rose with larger TKR size. However, in terms of percentages the correlation coefficient was almost nil if not negative showing a much weaker association between AP sliding distances, and wear in these TKR tests. This strongly contrasts how the wear rates correlated with the TKR size mentioned above.

The same could be inferred from the weak correlations of the wear patch sizes estimated at the end of testing of each implant. Interestingly, wear patch size proved to be a poor indicator of TKR size, let alone of the amount of wear, with poor correlation results in both cases. This was not unexpected as the wear patch area was not the same as contact area, and in reality it was essentially a "noisy" function of relative positions of femoral and tibial components visited at different phases of the walking cycle. The scars and patches provided little sense of proportion of what was visited and rubbed more, or stressed more, that might have caused surfaces to wear more.

A comprehensive review [12] of many published in-vitro test results discussed the interplay between the effects of stress and contact area. Proper synthesis and direct comparison of results were challenging because even at seemingly comparable nominal contact stresses, the contact areas and loads employed were different between studies. The published studies varied in other important ways too. Some were mere reciprocal linear translations, many aimed at mimicking motions in joint arthroplasties (i.e. translation and axial rotation of pins on discs to mimic TKA kinematics), and others deliberately maximized multidirectional paths and induced very high cross shear which is known to multiply accelerate wear. The formulations of the UHMWPE used in them were also not identical. They also varied in the level of crosslinking which may have introduced the strongest uncontrolled variable yet across the different studies. Various contradictions in the published literature were highlighted and explained in [12], but the review concluded that in the higher end of the stress range, decreasing contact area resulted in higher contact stress, which, if excessive, may cause fatigue wear and delamination.

So contact area needs to be increased to reduce stress to reduce wear in those situations. Some clinical retrieval studies clearly confirmed this historically accepted trend. For example, in 2007, Cottrell et. al. [7] showed from implant retrievals that by increasing conformity of a particular TKR design, the contact area increased and wear related damage was decreased. On the other hand, the literature review [12] also showed that in the moderate stress ranges, the higher contact areas themselves caused extra adhesive and abrasive wear. Therefore, as we have found in this study, in the more contemporary low stress TKR designs and better quality UHMWPE bearing material scenario, reducing contact area is desirable to reduce wear. For example, Fisher et. al. [8] demonstrated with pin-on-disc and simulator studies of a low conforming fixed bearing TKR design, that reduced

Continued

surface area led to reduced surface wear. Much like we are here, they also extrapolated from their results to question how contact area ought to be thought about in terms of its effect on wear and not through its surrogate effects on stress.

Therefore, a certain optimum threshold of contact area must balance the above conflicting trends. This can be implicitly interpreted from some published pin-on-disk test results [12, 21, 22], other TKR tests [1, 2, 4, 8, 13], and there is well-documented awareness of this phenomenon in total hip replacements. It is well accepted that larger hips for example are known to wear more than smaller ones under the same loads despite their lower contact stresses.

In both hips and knees, the larger size implants on larger boned patients also inherently involve longer sliding distances of articular motion, and the extra wear may be partly due to that too as well as due to the higher loads from the likely heavier patients. It is not easy to dissociate these variables in full TKR system force-controlled simulator tests, and this may be considered a limitation of our study. We could not fully distinguish whether the wear increase was from the more articular contact of larger implants, or from the higher motions due to the larger size, although these two factors were coupled and might have been considered inseparable in the reality of TKRs on patients. But the extra measurements and analyses of kinematics and wear scar areas we performed in this study showed relative weakness in kinematics as a confounding variable. Our conclusions remained consistent when we considered two of our tested subgroups which were even of the same TKR size, basic design and bearing materials but were different in surface shape conformity only, and thus differed only in contact area. They confirmed the same results (Fig. 11); the more conforming TKR which had the larger surface contact area wore marginally more. Note however a further complexity if this was taken too far in reality. Suppose a higher shape conformity was selected in a TKR of a significantly different design; it is fair to assume it would result in a much larger articular contact area, and the extra conformity may drastically reduce the motions under the same loads, as well as reduce stresses. Would that combination possibly increase or reduce wear under these conflicting effects? Our results here suggest the extra conformity would be counter productive in this scenario – as wear would probably increase. Going further, should larger size TKRs be designed by manufacturers to have less constraint to counter the effects of larger contact area? We do not advocate this level of complexity.

The choice of TKR size will always be dominated by patient anatomical considerations. Our results indirectly suggest that choices of relative sagittal and frontal radii of femoral and tibial components, and thus the overall articular surface conformity, in a modern TKR design and bearing, ought to follow the constraint/laxity and kinematics desired for best "function" to mimic the intact knee joint, over any previously dominant UHMWPE wear considerations.

12

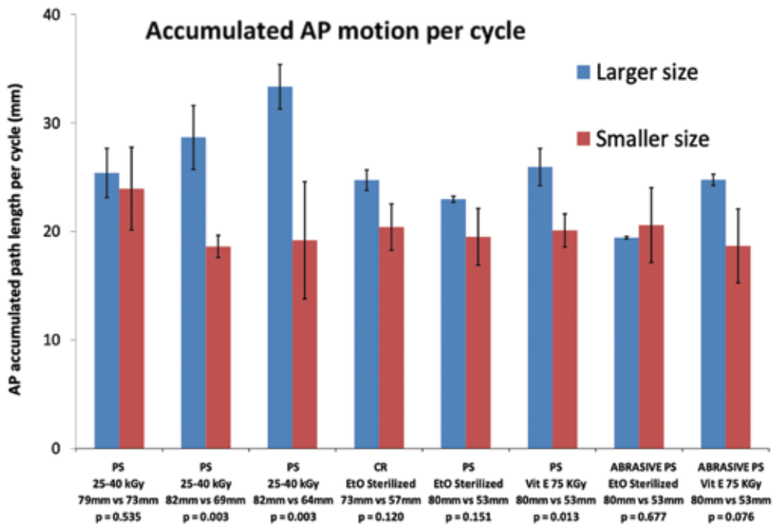


Figure 12: *Accumulated Anterior Posterior (AP) relative motions per cycle. They were larger for the larger TKR sizes in 7 out of 8 tests (but statistically significant different in only 3 out of 8).*

13

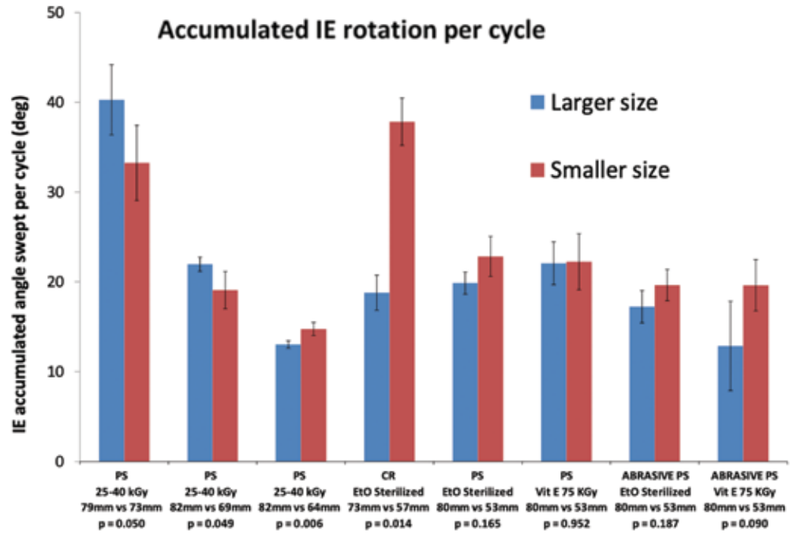


Figure 13: *Accumulated Internal-External (IE) relative angle swept (rotations) per cycle. No overall trend or consistent difference between large and small TKR sizes, nor was one expected.*

14

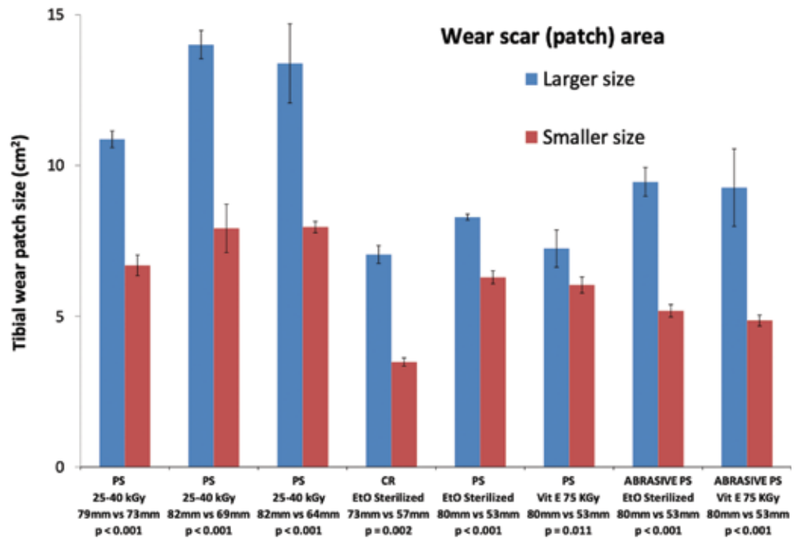
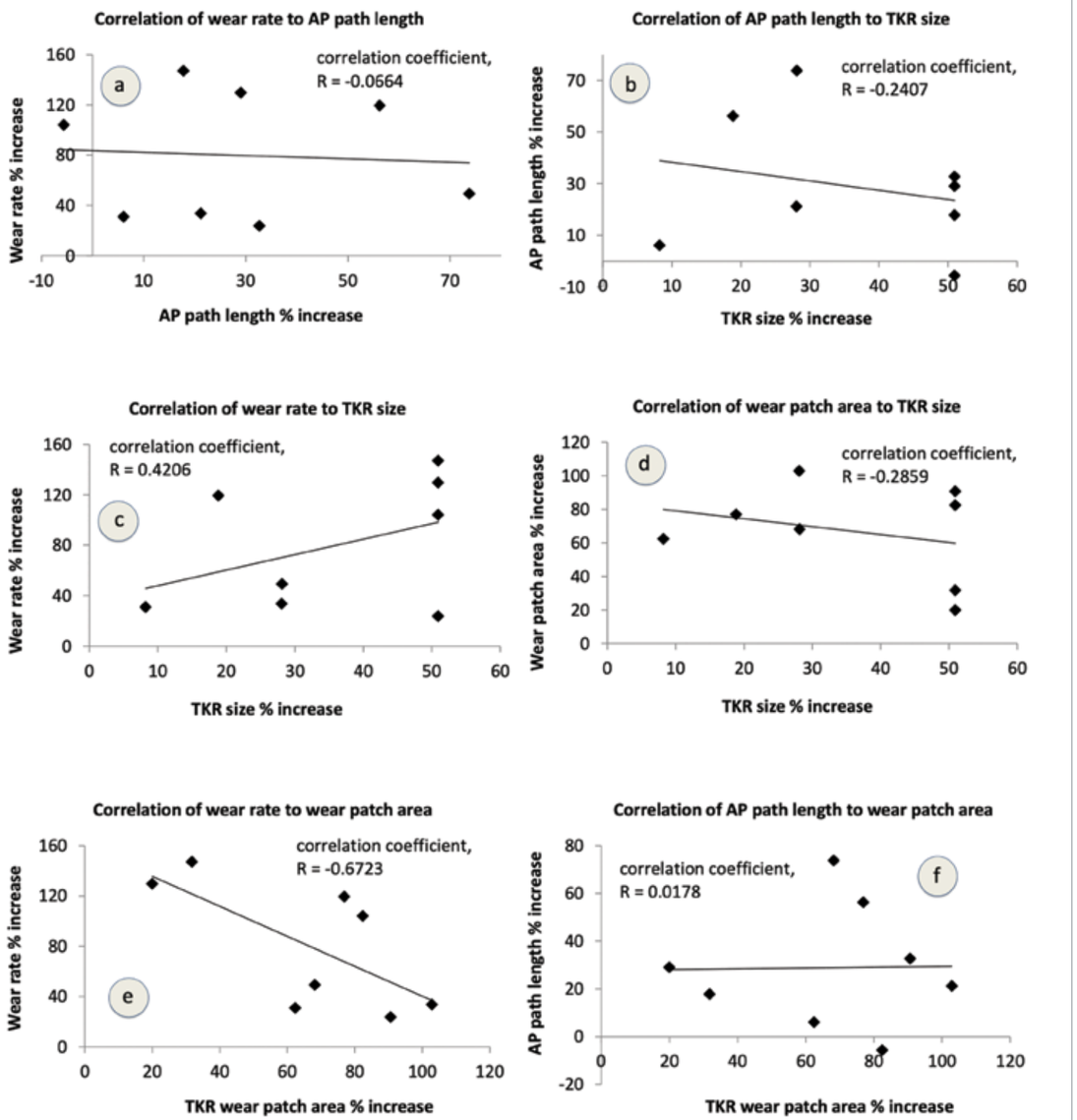


Figure 14: *Wear scar Patch area variation with TKR size. All larger TKRs had larger ($p \leq 0.011$) wear patches than their corresponding smaller ones.*

Continued

Correlation plots of the main and confounding variable to establish the most dominant associations between them

15



The findings of this study went a long way to answer our questions and empowered our challenge to the previous doctrine that lower contact stress by increasing contact area would decrease wear in TKR designs. We obviously limit this conclusion to reasonable modern TKR designs and materials where stresses are not excessive, and such that delamination wear would not occur. This data could shine a new beacon to guide future knee designers to be wary of excessively high contact area. With everything else equal, larger TKRs wear more than smaller ones. With equally sized contemporary designs and similar kinematics, a TKR with more conforming articular surfaces may wear more than less-conforming designs. With modern materials and processing, increasing contact area to decrease contact stress may be counter-productive and may result in increased wear.

REFERENCES

1. Abdelgaied A, Brockett CL, Liu F, Jennings LM, Jin Z, Fisher J. The effect of insert conformity and material on total knee replacement wear. *Proc Inst Mech Eng H*. 2014;1:98-106.
2. Affatato S, Grillini L, Battaglia S, Taddei P, Modena E, Sudanese A. Does knee implant size affect wear variability?. *Tribol Int*. 2013:174-181.
3. Bartel DL, Bicknell VL, Wright TM. The effect of conformity, thickness and material on stresses in ultra-high molecular weight components for total joint replacement. *J Bone Joint Surg Am*. 1986:1041-1052.
4. Toward the interpretation of the combined effect of size and body weight on the tribological performance of total knee prostheses. Int Orthop. 2014;6:1183-1190.
5. Bell CJ, Walker PS, Abeysundera MR, Simmons JM, King PM, Blunn GW. Effect of oxidation on delamination of ultrahigh-molecular-weight polyethylene tibial components. *J Arthroplasty*. 1998;3:280-290.
6. Callaghan JJ, O'rourke MR, Saleh KJ. Why knees fail: Lessons learned. *J Arthroplasty*. 2004;4 Suppl 1:31-34.
7. Cottrell JM, Townsend E, Lipman J, Sculco TP, Wright TM. Bearing surface design changes affect contact patterns in total knee arthroplasty. *Clin Orthop Relat Res*. 2007:127-131.
8. Fisher J, Jennings LM, Galvin AL, Jin ZM, Stone MH, Ingham E. 2009 knee society presidential guest lecture: Polyethylene wear in total knees. *Clin Orthop Relat Res*. 2010;1:12-18.
9. Freeman MAR, Swanson SAV, Todd RC. Total replacement of the knee using the freeman-swanson knee prosthesis. *Clin Orthop*. 1973:153-170.
10. Haider H. Tribological assessment of *UHMWPE in the knee. In: UHMWPE Biomaterials Handbook - Ultra-High Molecular Weight Polyethylene in Total Joint Replacement and Medical Devices*. Elsevier, Inc.; 2016:553-578.
11. Haider H. Wear: Knee joint arthroplasty. In: Ducheyne P, ed. *Comprehensive Biomaterials II*. Elsevier; 2017:152-174.
12. Haider H, Baykal D. Wear assessment of UHMWPE with pin-on-disc testing. In: Kurtz SM, ed. *UHMWPE Biomaterials Handbook - Ultra-High Molecular Weight Polyethylene in Total Joint Replacement and Medical Devices*. Third ed. Elsevier, Inc.; 2016:553-578.
13. Haider H, Weisenburger JN, Kurtz SM, Rimnac CM, Freedman J, Schroeder DW, Garvin KL. Does vitamin E-stabilized ultrahigh-molecular-weight polyethylene address concerns of cross-linked polyethylene in total knee arthroplasty?. *J Arthroplasty*. 2012;3:461-469.
14. Howling GI, Barnett PI, Tipper JL, Stone MH, Fisher J, Ingham E. Quantitative characterization of polyethylene debris isolated from periprosthetic tissue in early failure knee implants and early and late failure charnley hip implants. *J Biomed Mater Res*. 2001;4:415-420.
15. Ingham E, Fisher J. The role of macrophages in osteolysis of total joint replacement. *Biomaterials*. 2005;11:1271-1286.
16. International Standards Organization (ISO). ISO 14243-1 implants for surgery – wear of total knee-joint prostheses –Part 1: Loading and displacement parameters for wear-testing machines with load control and corresponding environmental conditions for test. 2009.
17. International Standards Organization (ISO). ISO 14243-2 implants for surgery – wear of total knee-joint prostheses – part 2: Methods of measurement. 2009.
18. Jones SM, Pinder IM, Moran CG, Malcolm AJ. Polyethylene wear in uncemented knee replacements. *J Bone Joint Surg Br*. 1992;1:18-22.
19. Kurtz SM, Hozack WJ, Purtill JJ, Marcolongo M, Kraay MJ, Goldberg VM, Sharkey PF, Parvizi J, Rimnac CM, Edidin AA. 2006 otto aufranc award paper: Significance of in vivo degradation for polyethylene in total hip arthroplasty. *Clin Orthop Relat Res*. 2006:47-57.
20. Lu S, Orr J, Buchanan F. The influence of inert packaging on the shelf ageing of gamma-irradiation sterilised ultra-high molecular weight polyethylene. *Biomaterials*. 2003;1:139-145.
21. Mazzucco D, Spector M. Effect of contact area on the wear of ultrahigh molecular weight polyethylene in bidirectional pin-on-flat articulation. ORS. 2003;Paper #0001.
22. Mazzucco D, Spector M. Contact area as a critical determinant in the tribology of metal-on-polyethylene total joint arthroplasty. *J Tribol*. 2006;1:113-121.
23. Popoola OO, Yao JQ, Johnson TS, Blanchard CR. Wear, delamination, and fatigue resistance of melt-annealed highly crosslinked UHMWPE cruciate-retaining knee inserts under activities of daily living. *J Orthop Res*. 2010;9:1120-1126.
24. Tipper JL, Galvin AL, Williams S, McEwen HM, Stone MH, Ingham E, Fisher J. Isolation and characterization of UHMWPE wear particles down to ten nanometers in size from in vitro hip and knee joint simulators. *J Biomed Mater Res A*. 2006;3:473-480.
25. Walker PS. Biomechanics of total knee replacement designs. In: Mow V, Huiskes R, eds. *Basic Orthopaedic Biomechanics and Mechano-Biology*. 3rd Edition ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2004:657-702.

Evaluation of Gender Differences in Glenoid Remodeling in Patients with Primary Shoulder Osteoarthritis

[1]Matthew J. Teusink, MD; Kent Rinehart, MD; Christopher Peters, MD; Anna Zajicek, MD

[1]University of Nebraska Medical Center, Omaha, Nebraska

INTRODUCTION:

Most common mode of failure of anatomic total shoulder arthroplasty is glenoid component loosening. The etiology for glenoid loosening is multi-factorial and may include implant design and surgical technique. Previous work has evaluated glenoid dimensions and gender differences in young, non-arthritic, cadaveric specimens. To our knowledge no previous study has compared gender differences in glenoid dimensions and morphology in patients with primary shoulder osteoarthritis. The purpose of this study is to compare glenoid morphology and wear patterns between male and female patients with primary shoulder osteoarthritis.

METHODS:

Following IRB approval, we performed a retrospective review of all patients who underwent an anatomic total shoulder arthroplasty by a single surgeon (MJT) for the diagnosis of primary osteoarthritis between August 2013 and July 2017. All patients had preoperative CT scans as part of their routine surgical planning. A total of 128 shoulders met our inclusion criteria. There were 59 male shoulders and 68 female shoulders. Glenoid version, inclination, and vault depth were measured by a fellowship-trained musculoskeletal radiologist. Glenoid wear pattern was also classified according to Walch et al. Glenoid version, inclination and vault depth were compared between males and females using the independent sample t-test. The association of Walch wear pattern with gender were evaluated using Fishers exact test. Statistical significance was set at $p<0.05$.

RESULTS:

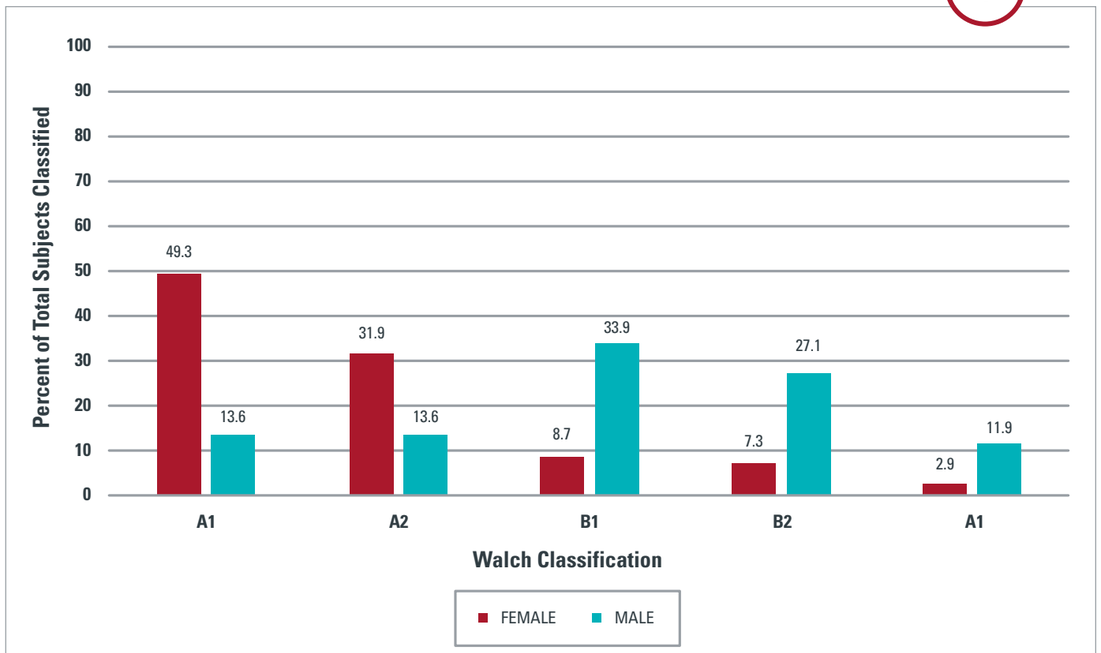
Male shoulders had significantly greater glenoid retroversion (17 degrees) than female patients (10 degrees). ($p<0.001$) Male shoulders also had significantly deeper glenoid vaults (2.1cm) than female shoulders (1.7cm) ($p<0.0001$) There was no difference in average glenoid inclination between male and female shoulders. (6.5 degrees inferior vs 8.6 degrees inferior) ($p=0.20$) Results of glenoid wear pattern by gender are shown in Table 1.

Overall, Walch classification demonstrated a greater posterior wear pattern amongst males and greater central wear amongst females, which was statistically significant (P-value <0.0001).

DISCUSSION:

This data reveals differences in glenoid wear between osteoarthritic males and female shoulders. Males demonstrate preferential posterior glenoid remodeling whereas females remodel centrally. The posterior wear pattern in males likely contributes to the relative increased posterior glenoid version as compared to females. The central wear pattern in females likely contributes to the relative smaller glenoid vault depth.
Data comparing glenohumeral morphology and wear secondary to osteoarthritis between sexes could provide valuable insight for glenohumeral implant design. Continued research evaluating glenoid osteoarthritis patterns between males and females is needed to improve longevity of total shoulder arthroplasty.

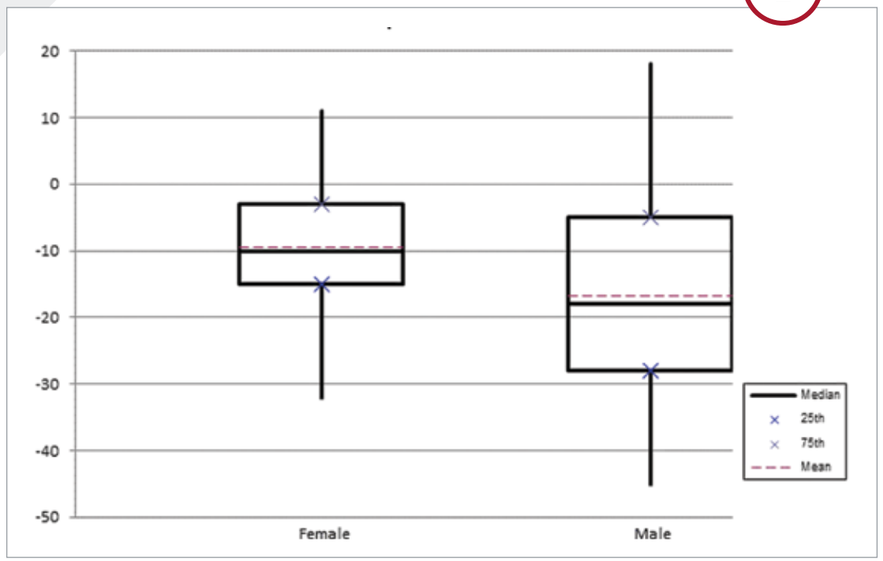
Percentage of Walch Classifications by Gender 1



Continued

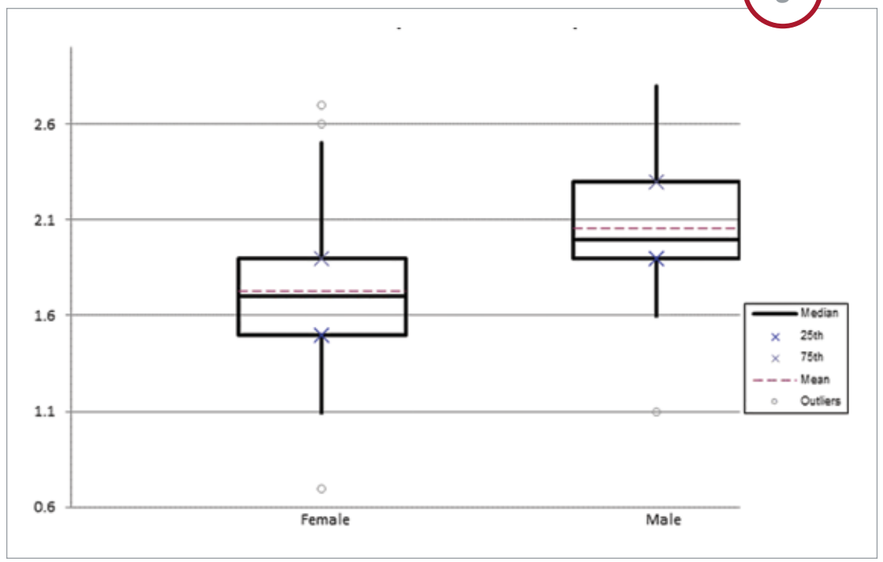
Gender Comparison: Glenoid Version

2



Gender Comparison: Glenoid Depth

3



CORE

Department of Orthopaedic Surgery and Rehabilitation

985640 Nebraska Medical Center
Omaha, NE 68198-5640

Phone: 402-559-8000
Fax: 402-559-5511

www.unmc.edu/orthosurgery

THANK YOU FOR YOUR INTEREST IN THE UNMC DEPARTMENT OF ORTHOPAEDIC SURGERY AND REHABILITATION,
AND FOR YOUR ONGOING SUPPORT OF THIS PUBLICATION.